

A
BRIEF HISTORY
OF
EPIDEMIC
AND
PESTILENTIAL DISEASES,
WITH THE
PRINCIPAL PHENOMENA OF THE PHYSICAL WORLD,
WHICH PRECEDE AND ACCOMPANY THEM,
AND OBSERVATIONS DEDUCED FROM THE FACTS STATED.

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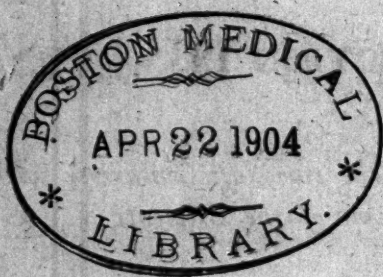
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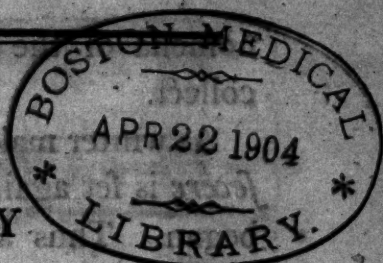
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A BRIEF

HISTORY



EPIDEMIC AND PESTILENTIAL DISEASES.

SECTION IX.

*Bills of Mortality for the two last Centuries, with
the principal Phenomena of the Elements.*

OUR accounts of diseases and the phenomena of the world, which appear to be connected with them, are altogether imperfect. But in the two last centuries we have a tolerable history of diseases, and occasionally an account of the seasons and remarkable occurrences. In the following tables the reader will find the Bills of Mortality for London, Augsburg, Dresden, Boston, one church in Philadelphia, with the bills of a few years for Paris and Dublin; to which are prefixed such of the remarkable phenomena

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nomena of the elements as I have been able to collect.

As winter makes a part of two years, the word *severe* is set against the year in which the winter began. Thus against the year 1607, the word *severe* refers to the winter of 1607—8. The blanks denote either that nothing singular occurred in those years, or that I have no account of the occurrences. Further enquiries might probably enable me to fill many of those blanks.

Bills of Mortality do not exhibit a complete view of epidemics, as some of the most remarkable, especially influenza, destroy but few lives; and the bills of the years when that disease alone prevailed are remarkably low. It is often the immediate precursor, in spring, of pestilential diseases in autumn, in which cases the bills of the year are very high.

OF EPIDEMIC DISEASES.

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A.D.	Seasons.		Comets.	Eruptions of Volcanoes.	Diseases Epidemic.	Burials in London.			Burials in Augsburg.
	Summer.	Winter.				By common Diseases.	By the Plague.	Total.	
1600	—	—	—	—	Pestilence general	—	—	—	1775
1601	Very dry	Severe	—	South-America	Plague in Portugal, and many places	—	—	—	1570
1602	Cool & dry	Cold	—	—	Influenza, plague	—	—	—	1567
1603	—	—	—	—	Plague in London, and general famine	5773	36269	42042	1488
1604	—	—	Comet	South America	—	4323	896	5219	1298
1605	—	—	—	—	—	5948	444	6392	1361
1606	—	—	—	—	—	5796	2124	7920	1371
1607	Hot	Severe	Comet	Etna	Plague in Cork	5670	2352	8022	2595
1608	Hot	—	—	—	Plague in Cork; dysentery	6758	2262	9020	1476
1609	—	Severe	Comet	Etna	Plague in Denmark	7554	4240	11784	1469
1610	Very dry	—	—	—	Influenza in Europe; anginas in Spain	7486	1803	9289	1941
1611	—	—	—	—	Plague in Constantinople	6716	627	7343	1891
1612	Very dry	—	Comet	—	Fever	7778	64	7842	1625
1613	—	—	—	—	Plague in Constantinople	7503	16	7519	1722
1614	—	Severe	—	Etna	Fatal small-pox in Europe; measles in Persia	7367	22	7389	1444
1615	Cool	—	—	—	—	7850	37	7887	1771
1616	{ Hot & dry, } England	—	—	—	—	8063	9	8072	1631
1617	{ Hot & dry, } England	—	—	—	—	8280	6	8286	1514
1618	—	—	Comets	—	{ Pestilence among the Indians in America; } fatal anginas in Naples	9596	18	9614	1354
1619	—	—	—	Iceland	Pestilential fevers in France	8000	9	8009	1485

[illegible]

OF EPIDEMIC DISEASES.

A.D.	Seasons.		Comets.	Eruptions of Volcanoes.	Diseases Epidemic.	Burials in London.			Burials in Aug. & in Dec.	Burials
	Summer.	Winter.				By com. Diseases.	By the Plague.	Total.		
1640	—	Sever. Eu.	—	—	—	11321	1450	12771	586	935
1641	—	Severe Am.	—	—	—	11767	1375	13142	587	525
1642	—	—	—	—	—	11999	1274	13273	593	601
1643	Hot & dry	—	—	Etna and Vesuvius	—	12216	996	13212	638	1041
1644	—	—	—	—	—	9441	1492	11933	659	489
1645	Hot, Eng.	—	—	—	Sickness among the Indians in America	9608	1871	11479	758	532
1646	—	—	—	—	Plague increased in London	10415	2365	12780	1488	481
1647	Hot, Am.	—	Comet	—	{ Increase of plague in London; influenza and pettilential fever in America	10462	3597	14059	1388	471
1648	—	—	—	—	{ Plague in Ireland; malignant fevers in Italy, France, and Spain	9283	611	9894	1208	606
1649	—	—	—	—	{ Plague in Spain; small-pox in Boston	10499	67	10566	940	597
1650	—	—	—	Etna	{ Plague in Cork; influenza in Europe	8749	15	8764	533	494
1651	Hot	—	—	—	{ Quinsey in Italy	10444	23	10467	577	511
1652	Dry, Eng.	—	Comet	—	{ Fevers	12588	16	12604	616	450
1653	Dry, Eng.	—	—	—	{ Sickness in New England	10081	6	10087	575	535
1654	—	Severe	—	—	{ Plague in Denmark, Turkey, Chester in Eng- land, &c.	13231	16	13247	764	558
1655	Dry, Eng.	—	—	Vesuvius	{ Plague general in Europe; influenza in America	11368	9	11377	570	525
1656	Hot	—	—	—	{ Plague in Italy, &c.	13915	6	13921	641	560
1657	Hot	Severe	—	—	{ Plague in Genoa	12436	4	12434	731	663
1658	Wet, Am.	—	—	—	{ Influenza in Europe; sickness in America	14979	14	14993	731	518
1659	—	—	—	—	{ Cynanche trachealis in America	14720	36	14756	831	599

A BRIEF HISTORY

A. D.	Seasons.		Comets.	Eruptions of Volcanos.	Diseases Epidemic.	Burials in London.			Burials in Aug.	Burials in Dec.
	Summer.	Winter.				By com. Diseases.	By the Plague.	Total.		
1660	—	—	—	Iceland & Vesuvius	Measles in England	15104	14	15118	657	542
1661	—	—	Comet	—	Measles; tertians severe in London for four years	19791	20	19811	668	649
1662 Dry, Am.	—	—	—	—	Sickness in America	16542	12	16554	788	637
1663	—	Mild	—	—	Fevers; diseases among cattle; plague in Holland	15347	9	15356	836	620
1664 Wet	—	Severe	Comet	Etna	Purple fevers in Prussia; corn first mildewed in America	18291	6	18297	761	662
1665	—	—	Comet	Etna	Plague in London and over Europe	28710	68596	97306	745	699
1666 Hot and dry	—	—	Comet	Etna	Dysentery over Europe; small-pox in Boston	10840	1998	12838	737	824
1667	—	—	—	Etna	Fevers	15841	36	15877	769	823
1668 Hot	—	Severe	Comet	Etna	Pestilence in New York; small-pox in Europe	Plague in London ceased.				
1669 Hot	—	Severe	—	Etna, great	Dysentery, fevers, measles, in Europe; cat plague in Westphalia					
1670	—	—	—	Etna	Measles in London; small-pox	19436	—	19436	743	794
1671	—	—	—	Etna	Measles and small-pox	20198	—	20198	734	776
1672	—	—	Comet	Etna	Catarhs	15729	—	15729	733	743
1673 Cold, Eng.	—	Cold	—	Etna	Measles and small-pox	18230	—	18230	768	909
1674	—	—	—	Etna	Influenza in Europe	17504	—	17504	751	909
1675 Wet & cool, Eng.	—	Severe	Meteor	Etna	Measles and small-pox	21201	—	21201	842	846
1676	—	—	Meteor	Etna	Small-pox in Charlestown, in Massachusetts; dysentery in Denmark	17244	—	17244	913	947
1677	—	—	Comet	Etna	Severe plague on the Barbary Coast; small-pox in Boston and in South America	18732	—	18732	913	1284
1678 Dry and hot	—	—	Comet	Etna		19067	—	19067	934	887
						20678	—	20678	943	1020

OF EPIDEMIC DISEASES.

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A. D.	Seasons.		Comets.	Eruptions of Volcanoes.	Diseases Epidemic.	Burials in	
	Summer.	Winter.				London.	Dresden.
1679	—	Severe	Comet	Etna	Catarrh in Europe; plague in Vienna	21730	945
1680	Hot and dry	Severe	Comet	—	Plague in Dresden; coughs, dysentery	21053	976
1681	Very dry	—	—	—	—	23971	800
1682	—	—	Comet	Etna and Vesuvius	—	20691	734
1683	—	Very severe	Comet	—	{ Plague at Halle; spotted fever in Dublin; } murrain among cattle	20587	808
1684	Hot and dry, Eng.	Cold in Eng.	—	—	Malignant dysentery over Europe	23202	858
1685	Hot and dry, Eng.	—	—	—	—	23222	848
1686	Dry, Italy	—	Comet	Etna and a meteor	—	22609	981
1687	Rainy, Europe	—	—	—	—	21460	835
1688	—	Severe	—	Vesuvius	Influenza in Europe	22921	860
1689	Rainy, Autumn	—	Comet	Etna and Vesuvius	{ Small-pox in Boston; spotted fever in Ger- } many	23502	806
1690	Rainy	Severe	—	—	Corn mildewed	21461	1071
1691	Hot and dry	—	—	—	{ Corn blasted; diseases among cattle; spotted } fever in Europe	22691	785
1692	Hot	—	—	Etna	Malignant fevers in Europe	20874	935
1693	—	—	—	Etna and Iceland	Influenza in Europe	20959	1084
1694	Hot	Cold, Europe	—	Vesuvius and Banda	Malignant fevers	24100	1106
1695	Rainy, Europe	—	—	—	{ Apoplexies in Italy; measles and chin-cough } in Europe; sickness in America	19047	1048
1696	Cold & wet, Eng.	—	—	—	Dysentery among children; spotted fevers	18638	927
1697	—	Severe	—	—	{ Spotted fevers in Europe; Influenza in Ame- } rica began	20970	777
1698	—	Severe	Comet	South America	Influenza in America; spotted-fever in Europe; malignant puerisy in America	20183	877
1699	Hot, America	—	Comet	—	Influenza in Europe; plague in Philadelphia and Charlestown, and Levant	20795	940
1700	—	Mild	—	—	Sore throat in Levant; catarrhs and measles in Europe	19443	786

A.D.	Seasons.		Comets.	Eruptions of Volcanoes.	Diseases Epidemic.	Burials in			
	Summer.	Winter.				London.	Augsb.	Dresden.	Boston.
1701	Hot and dry	—	—	Vesuvius	Plague in the East	24071	906	992	146
1702	Hot and dry	—	Comet	Etna	{ Plague in Poland and in New York; small pox in Boston }	19481	900	946	441
1703	—	—	—	—	Plague in Poland	20720	1245	1078	159
1704	Dry, Europe	—	—	Ves. & Teniffe.	Plague in Poland and Hungary	21684	1313	964	220
1705	—	—	—	—	Plague in Russia	22097	748	1346	282
1706	Hot & dry, Eng.	—	Comet	—	Coughs and dysentery among children	19847	842	1098	261
1707	Very hot	—	Comet	Vesuvius	Measles in England	21600	805	1523	263
1708	—	Very severe	—	Meteor	Catarrh began in Europe; plague in Thorn	21291	908	1119	291
1709	—	—	—	—	{ Catarrh, epidemic, plague in Dantzick; apoplexies }	21800	805	1340	377
1710	—	—	—	—	{ Plague in Lithuania; catarrhus fevers in England and Holland }	24620	811	1214	295
1711	—	Cold, Europe	—	—	{ Plague in Copenhagen, and among cattle terrible }	19833	855	1222	363
1712	Wet, England	—	Comet	Vesuvius	Catarrh in Europe; plague in the East	21198	894	1140	316
1713	Wet, England	Mild	—	—	Measles in America; plague in Austria	21057	860	1383	480
1714	Dry and hot, Eng.	—	—	—	—	26569	948	1250	413
1715	Dry, England	—	—	—	Small-pox and measles in England	22232	1024	1353	336
1716	Very dry, Eng.	Severe	—	—	—	24436	905	1274	355
1717	—	Great snow in Am.	Comet	Vesuvius	Catarrhs in Europe	23446	988	1908	451
1718	Hot & wet, Eng.	—	Comet	—	{ Malignant fevers; plague in Turkey Plague in Levant; pestilential fevers, malig- nant pleurisy in America }	26523	768	1412	380
1719	—	—	Meteor.	—	—	28347	997	—	304

A. D.	Seasons.		Comets.	Eruptions of Volcanoes.	Diseases Epidemic.	Burials in				Xst. Ch. & St. Peter's, Philadel.
	Summer.	Winter.				London.	Dublin.	Dresden.	Boston.	
1720	Dry, Europe	—	—	—	{ Plague in Levant, and in Marseilles; malignant fever in America	25454	—	1733	329	—
1721	—	—	—	Iceland		26142	—	1850	1102	—
1722	Cold & wet, Eng.	—	—	—		25750	—	1519	273	—
1723	—	Cold	Comet	—	{ Small-pox in England, and plague in Barbadoes	29197	—	1654	413	—
1724	Wet, England	—	—	Two in Iceland	{ Hooping-cough in England	25952	—	1761	407	—
1725	Wet, England	—	—	—		25523	—	1642	324	—
1726	—	—	—	Vesu. & Iceland		29647	2763	—	343	69
1727	Very hot, Am.	—	Comet	Iceland	{ Plague in Egypt Sickness in America Plague in Egypt, and in Carolina Epidemic catarrh in Europe; plague in Aleppo; measles and malignant pleurisy in America	28418	2946	—	479	130
1728	Hot, Am.	—	—	—		27810	—	—	498	86
1729	—	—	Comet	Iceland		29722	3206	—	570	88
1730	—	Severe Eu.	—	Vesu. & Iceland	{ Small-pox in Boston; pestilential fevers in South America	26761	2184	—	909	81
1731	—	—	—	—		23262	—	—	408	166
1732	—	Severe Am.	Comet	—		23358	2534	—	499	97
1733	Dry, England	—	—	—	{ Universal catarrh; plague in Aleppo Scarlatina in Edinburgh; small-pox and fevers in Europe Sore-throat in America; measles, coughs, catarrhs, fevers, hydrophobia, in Europe Sore-throat in America and France; measles in England; dreadful plague in Egypt	29233	2608	—	438	103
1734	—	—	—	—		26662	2466	—	528	116
1735	Wet	—	—	—		23538	2196	—	455	96
1736	Wet, Am.	—	—	—	{ Severe catarrh universal; diseases among horses Measles in America; pestilence in Barbadoes, New Spain, Oczakow Pestilence in Charlestown; measles in America	27581	2101	—	617	144
1737	—	Very sev. Am.	Comet	Vesuvius		27823	—	—	607	112
1738	—	—	—	—		25825	2506	—	576	107
1739	Wet, England	Very sev. Eu.	Comet	—		25432	2201	—	554	97

A D.	Seasons.		Comets.	Eruptions of Volcanoes.	Diseases Epidemic.	Burials in			
	Summer.	Winter.				London.	Dublin.	Boston.	Xst. Ch. & St. Peter's, Philadel.
1740	—	In Am. very severe	—	—	Measles in America; hooping cough and spotted fevers in England	30811	—	704	98
1741	—	—	—	—	Pestilence in Philadelphia and Virginia; spotted fever in England	32169	2790	555	162
1742	—	Severe, Syria	Comet	—	Sore-throat in America and England; plague in Syria, &c.	27483	2320	517	123
1743	Hot	—	Comet	South America	Plague in Syria, Messina, New York, &c.	25200	2193	620	116
1744	—	—	—	—	catarrh in Europe	20606	1705	497	114
1745	—	—	—	—	Influenza in Europe	21296	—	780	125
1746	—	—	—	—	Plague in Egypt; fevers and dysentery in America	28157	1957	578	186
1747	Hot and dry	Severe	—	South America	Fever at Albany; dysentery in Switzerland	25494	—	777	192
1748	Dry	—	—	Etna	Pestilence at Philadelphia; anginas in England; catarrh in Europe	23869	1530	740	175
1749	Very dry, America	—	—	—	Pestilence in Charlestown; long fever in America; anginas in England	25516	1819	677	128
1750	Very hot, America	Very fevere	Comet	—	Dysentery in Europe and America; long fever; anginas in England	23727	2088	604	125
1751	Wet, England	Severe	—	Vesuvius	Dysentery and anginas in America and Europe; plague on the Barbary Coast	21028	—	644	144
1752	Very hot, America	—	—	—	Dysentery and anginas in America; plague in Turkey	20485	1844	1009	129
1753	—	Severe	—	—	Small-pox in Boston; dysentery and anginas in America and Ireland	19276	1825	481	105
1754	—	Mild in America	—	Vesuvius	Gangrenous sore-throat in England, Ireland, and America	22696	1897	434	94
1755	—	Severe, Europe	—	Etna	Influenza in Europe; anginas in Europe and America; plague in Turkey	21917	2002	484	99
1756	—	Severe, Syria	Comet	Iceland	Influenza in America began	20872	1550	526	213
1757	—	—	—	—	Influenza in America, and measles	21313	1825	434	97
1758	Hot	—	Meteor	—	Influenza in Europe; plague began in Egypt and Smyrna; measles in America	17576	1558	524	129

A. D.	Seasons.		Comets.	Eruptions of Volcanos.	Diseases Epidemic.	Burials in			
	Summer.	Winter.				London.	Dublin.	Boston.	Xr. Cl. & St. Peter's, Philadel.
1760	—	—	—	Vesuvius	Plague in Levant; fevers in America	19830	1993	576	174
1761	Very dry, Am.	—	—	Azores	Influenza in America, and malignant fever; plague in Levant	21063	2292	465	144
1762	Very dry, Am.	Very severe	Comet	—	Influenza in Europe; pestilence in Philadelphia; crisis of plague in Aleppo	26326	2490	531	200
1763	—	—	Meteor	Etna	Pestilence at Nantucket, and at Bengal; mortality among animals	26143	2605	407	180
1764	Hot, Europe	—	—	Etna	Pestilence at Cadiz, and in Naples; small-pox in Boston	23202	2307	548	139
1765	Hot, Europe	Severe, Eu.	—	—	Dysentery in Europe	23230	2275	560	186
1766	Hot & dry	Very severe	Comet	Etna, Vesu. & Heckla	Dysentery in America	23911	Paris.	445	133
1767	—	Cold	Comet	Vesuvius, great	Influenza in Europe	22612	19875	468	121
1768	Hot	—	—	—	Diseases among horses in America	23639	20808	417	123
1769	Hot	—	Comet	—	Measles and sore-throat in America; diseases among cattle	21847	18427	645	188
1770	Wet, Eng.	—	Comet	Ternate and Vesuvius	Sore-throat in America and West-Indies; plague in Constantinople	22434	18719	483	127
1771	Wet, A. & E.	Cold, Eu.	Meteor	Vesuvius	Plague in Russia; diseases among cattle; pestilence in Bengal	21770	18941	482	139
1772	Hot, Am.	Cold spring	—	—	Influenza and measles in America	26053	20374	517	157
1773	—	—	—	—	Measles, anginas, and dysentery in America; plague at Bassora and Bagdad	21656	18518	595	179
1774	—	Severe Eu.	—	—	Scarlet fever in Edinburgh and Philadelphia	20884	—	596	161
1775	—	—	Meteor	Guatemala	Influenza in Europe; anginas and dysentery in America	20541	18400	—	156
1776	Hot & wet, A.	Severe Eu.	—	Vesuvius	Dysentery and anginas in America	19048	—	—	180
1777	—	—	—	Ferro	Dysentery and anginas in America	23334	—	—	222
1778	Hot	Very mild	—	—	Plague in Constantinople; typhus in America	20399	17112	—	183

A. D.	Seasons.		Comets.	Eruptions of Volcanoes.	Diseases Epidemic.	Burials in		
	Summer.	Winter.				London.	Salem Mass.	Xst. Ch. & St. Peter's, Philadel.
1779	Hot	Very severe	—	Vesu. great	Health	20420	—	143
1780	Hot, America	—	Halo	Etna	{ Some fever in Philadelphia; general health in America; plague in Smyrna }	20517	—	158
1781	—	—	—	—	Influenza in America	20709	—	179
1782	Dry autumn	—	—	—	Influenza in Europe; scarlatina began in Edin.	17918	175	198
1783	Hot	Very severe	Many mets.	Heckla, great	{ Measles and scarlatina in America; famine in India; plague in Egypt }	19029	189	232
1784	Hot	—	Comet	Vesuvius	Angina in America, and canine madness;	17828	140	230
1785	Dry, Europe	—	—	Vesuvius	plague and famine in the East.	18919	144	166
1786	Cool	Cold	—	—	Angina and fevers in America	20454	138	156
1787	Cool	—	—	Etna & Vesu.	{ Yellow fever in Cadiz; angina in America and England }	19347	110	147
1788	Rainy, America	Cold, Am. sev. Eu.	Met. Com.	—	{ Plague on the Barbary Coast; general health Measles began in America; sickness of cod- fish; influenza in Europe }	19697	144	126
1789	Cool spr. hot sum.	Mild, America	Halo	Vesuvius	{ Measles and influenza in America; famine in India and China; dearth in America; }	22744	129	164
1790	—	—	—	—	plague in the East; death of haddock	18038	203	145
1791	Very hot, America	Cold, America	—	—	Influenza a second time epidemic in America	18760	148	183
1792	—	Cold, America	—	—	{ Pestilence began in Egypt, Grenada, and New York }	20213	148	125
1793	Dry & very hot, Am.	Mild, America	Comet	—	{ Pestilence in Egypt; scarlatina began in Am. Scarlatina in America and London; pestilence in Philadelphia; dysentery in Maryland }	21749	148	393
1794	—	Mild, Am. sev. Eu.	—	Vesuvius, great	{ Scarlatina; pestilential fever in Newhaven and Baltimore; dysentery in Derby Scarlatina in Boston; pestilence in New York and Norfolk; dysentery in Newhaven; }	19241	122	172
1795	Hot & rainy, Am.	—	—	—	{ influenza in Europe Scarlatina in Boston and Newhamp. pesti- lence in New York, Boston, Charlestown, and Newbery-port; measles in America }	21179	195	223
1796	Dry autumn, Am.	Cold, America	—	—	{ Influenza in Europe; pestilence in Philadel- phia, Baltimore, Norfolk, and Providence; }	19288	216	213
1797	Cool, America	Severe, America	Comet	—	{ canine madness; plague among cats, and }	17014	147	197

SECTION X.

Remarks on the preceding History and Tables.

IMPERFECT as ancient history is, in regard to the account of diseases, and the extraordinary phenomena of nature, we find that between the year B. C. 480 and the Christian era, a number of violent plagues occurred, most of which coincided in time with the following phenomena: comets, eruptions of volcanoes, earthquakes, drought, severe winters, diseases among cattle. Of thirteen comets mentioned in the foregoing history, which are all whose dates I am able to ascertain, *eight* of them coincide with volcanic eruptions of Etna, the only volcano of any note which the history of that period has recorded; and eleven of them coincide in time with pestilence. If we consider the scarcity of our materials for a history of these phenomena at that period, and make due allowances for the uncertainty of chronology, we shall find reason to be surprized at such a number of these coincidences. In several instances we find extreme drought and very severe winters to correspond in time with comets and eruptions of Etna, conformable to facts in modern days.

On this subject history is barren also for many centuries after the Christian era. Yet in every period, even of the dark ages, we find numerous coincidences of the great phenomena above-mentioned. All the great plagues that have afflicted mankind, have been accompanied with violent agitations of the elements*.

This observation rests particularly on the events that preceded and attended the pestilences of the following periods, A. D.—80, 167, 252, 375, 400, 445, 542, 558, 590, 639, 679, 682, 745, 762, 802, 905, 994, 1005, 1031, 1044, 1069, 1106, 1135, 1142, 1162, 1181, 1222, 1242, 1300, 1347, 1368, 1400, 1477, 1500, 1531, 1577, 1602, 1625, 1636, 1665, 1699, 1709, 1719, 1728, 1743, 1751, 1760, 1770, 1783, 1789. Many facts in other periods concur to prove the truth of the remark.

* Modern philosophy objects to the popular sense in which the word *elements* is used; since it appears that what has usually been considered as an *element*, is found, by modern chemistry, to be a compound substance, resolvable into parts, in their nature and properties distinct. Notwithstanding these discoveries, I cannot consent to discard the popular use of the word *element*. Nature presents to the senses of man fire, earth, air, and water, in particular and predominant form. This is the form in which they appear to be most useful to man, and to be the constituent materials of other substances, as well as the agents in carrying on the great visible operations of the system. I therefore consider the popular distribution as natural and convenient.

The

The phenomenon most generally and closely connected with pestilence is an earthquake. From all the facts that I can find in history, I question whether an instance of a considerable plague in any country can be mentioned which has not been immediately preceded or accompanied with convulsions of the earth. If any exceptions have occurred, they have escaped my researches. It does not happen that every place where pestilence prevails is shaken; but during the progress of the diseases which I denominate *pestilence*, and which run, in certain periods, over large portions of the globe, some parts of the earth, and especially those which abound most with subterranean fire, are violently agitated.

By adverting to the foregoing history, the reader will find that all those years in which considerable earthquakes have occurred in America have been remarkably sickly. These years are 1638, 1647, 1658, 1662 and 3, 1668, 1727, 1755, 1783. See the history and the Bills of Mortality. Even the lighter shocks have been attended with considerable sickness, or have introduced a series of epidemics, being contemporary with the measles, influenza, or sore throat, as in 1669, 1720, 1737, 1757, 1761, 1769, 1771, 1791, 1797.

To enumerate the instances in Europe and Asia would be a useless repetition of the events related

related in the preceding history, to which the reader is referred.

Another phenomenon, which, next to earthquakes, appears to be most closely connected with epidemic diseases, is the eruption of fire from volcanic mountains. In this article history is deficient, for I have not been able to find the works necessary to furnish a complete view of these phenomena. There are whole centuries in which the books I have consulted mention no eruption of Etna and Vesuvius. The account of eruptions in Iceland, from the year 1000, taken from Pennant's Arctic Zoology, vol. i. 331, is probably complete, or nearly so. Of the volcanoes in the Andes we have very few accounts, as well as of those in the Moluccas. Of those in the Arctic regions of Asia and America we know very little.

Notwithstanding these defects, we are able, by the eruptions in Italy, Sicily, and Iceland, to arrive to some very important conclusions. The reader must have noticed in the preceding history the coincidences in time between volcanic discharges and winters of unusual severity. These discharges either precede or follow the winter. Thus the eruptions of 1766, 1779, and 1783, were immediately followed by intensely cold winters. The severe winters of 1762—3 and 1779—80, were speedily followed by eruptions. These instances will serve as samples of the ordinary

nary course of these events. Sometimes the eruptions continue, or are repeated, for a number of years in succession; but the eruptions, when continued, are moderate, and the seasons variable. When the volcanoes have been for some years quiet, and that suspension is followed by a great discharge, it appears to me that severe winters invariably follow or precede the discharge within a few months. So also, when an eruption is continued for a number of years, if at any time the discharge becomes violent, a severe winter attends it, as in 1669. Etna was in a state of eruption from 1664 to 1679; but in 1669 the discharge was immediately augmented, and the winters next preceding and following were very severe.

There are some years in which eruptions are noted, of which I find no account respecting the seasons. Perhaps some of these will, on further investigation, be found to be exceptions.

It is to be observed, that in some cases a severe winter extends to both hemispheres, sometimes to one only, and in a few cases to a part of a hemisphere only. Thus in 1607—8, 1683—4, 1762—3, 1766—7, 1779—80, 1783—4, the severity extended to both hemispheres. In 1640—41, 1739—40, and in other instances, the severe winter in Europe preceded, by one year, a similar winter in America. In a few instances, severe frost takes place in one hemi-

sphere during a series of mild winters in the other; but this is less common. In general, the severity happens in both hemispheres at once, or in two winters in immediate succession; and, as far as evidence has yet appeared, this severity is closely attendant on volcanic discharges, with very few exceptions.

Another phenomenon, which usually coincides in time with severe winters, is the approach of comets. I have been struck with surprize at the coincidences of this kind. There are a few instances on record of mild winters during the appearance of these bodies; but in these cases the comets have appeared to be small, or to pass the system at an immense distance from the earth. The large comets, and those which approach near the earth, *seem* to produce almost uniformly great heat, excessive drought, followed by very cold winters, tremendous storms of wind, rain, snow, and hail, unusual tides, or swell of the ocean, and usually volcanic eruptions. How far these phenomena are connected, as cause and effect, future observations may determine. Some of them occur so uniformly in the same year, that I cannot resist the evidence of their connection.

After a volcano has been many years quiet, its discharges are, I believe, always preceded by extreme drought; and this defect of water is not only observable in the vicinity of the volcano, but

but often extends over a whole continent, if not over the world. Many instances have been related: it is sufficient here to mention the excessive drought in 1762 and 1782, preceding eruptions of Etna and Heckla. In these years almost all springs were exhausted over a great portion of America.

Cold winters sometimes follow wet seasons, but more generally a very hot summer, or very dry autumn. Sometimes two or three severe winters occur in succession, as in 1766—67 and 68, and in America from 1796 to 1799.

The years when comets approach, or volcanoes discharge fire, and when the atmosphere exhibits fiery appearances, as meteors, streams of light, and mock suns, are beyond comparison the most tempestuous. Witness the years 1766, 1771 and 72, 1780, 1783, 4, and 5, 1788, 1797. In such years the risk on vessels at sea is greatly increased.

As dry seasons usually precede volcanic eruptions, so very wet seasons often follow them. This seems not to be the invariable course of events; but there are remarkable instances of deluging rains after these discharges. Witness the seasons following the universal convulsions of the earth in 1692 and 3, and 1766. Thus the electricity is reconducted to the earth.

In every case, I believe this remark will be found true, that the approach of comets and

volcanic eruptions disturb the regular course of the seasons. The heat of summer and the cold of winter are in extremes; more snow is generated in winter, and more hail in summer; tempests are more violent and frequent; meteors more numerous; and rain more unequally distributed over the earth.

A series of epidemic diseases, measles, influenza, affections of the throat, followed by pestilential fevers, appear generally to commence, and take their departure, from some of the great agitations of the elements above recited. This, at least, has been the case in America in the four last periods, beginning with 1756—7, 1769 and 70, 1782 and 3, 1788 and 9. This fact will want no authority but a bare inspection of the preceding history and tables.

The continuance and the varieties of the diseases seem to depend on similar disturbances in the elements; and as the discharges and motions of the electrical fluid depend on no certain laws that are known, they are irregular, and may contribute to vary the order and the nature of diseases. In some cases there has been a continued series of epidemics for twenty years, in which the common order is not exactly observed; but this is not frequent. A remarkable instance occurred between 1727 and 1744.

Those

Those periods, in general, have been most distinguished for sickness over the world, in which the fire of the earth has exhibited the most numerous and violent effects. Witness the period from 1631 to 1637, when the three most noted volcanoes discharged immense quantities of fire and lava, and severe pestilence extended over all Europe and America. A similar remark may be made concerning the period of the last universal pestilence in Europe, from 1663 to 1666—also from 1691 to 1695—from 1727 to 30—from 1759 to 1764—1769 to 1772—1774 to 1777—1783 to 1786—and concerning some shorter periods, all of which produced epidemics in both hemispheres.

Slighter eruptions and earthquakes, which are almost annual, seem to have less effect. The fire of the globe is in perpetual motion or action; and to this great agent, philosophers are agreed, are to be ascribed the changes of seasons, and the generation of rain, hail, and snow. Its operations, however, are not all of them visible, nor even perceptible, until they appear by their effects. It is probable that the *invisible* operations of the electrical fluid produce more effects than those which are seen. Indeed, we may question whether most of the visible phenomena of that principle are not mere effects of that action which influences the vege-

table and animal world. It is probable to me, that neither seasons, earthquakes, nor volcanic eruptions, are the causes of the principal arrangements we behold in animal and vegetable life, but are themselves the *effects* of those motions and invifible operations which affect mankind. Hence catarrh and other epidemics often appear *before* the vifible phenomena of eruptions and earthquakes.

P. S.—After this work was prepared for the prefs, I was favoured, by Doctor Mitchel, with fome extracts from a paper of Mr. Holm, a Swede, on the fubject of a volcanic eruption in Iceland, in 1783, by which it appears that the atmosphere is rendered peftilential by difcharges of fire and lava from the earth. This effect is fupposed to be wrought by a combination of the feptous and oxygenous parts, and may confirm and improve Doctor Mitchel's theory of peftilential air.

This eruption I underftand to have been a burfting of fire from the earth, in a place diftant from Heckla. In the neighbourhood of the column of flame were generated fnow, hail, and extreme cold. The water that fell in rain was acid and corrofive—deftraying cattle and men—covering the bodies of cattle with puftules and
ulcers,

ulcers, and excoriating the hands and faces of men when it fell on them. It also killed vegetables. The effects were felt not only in Iceland, but in Norway and other parts of Europe.

Had this treatise fallen into my hands some months ago, I might have been able to illustrate particular parts of my theory by authentic facts taken from that work. As it is, I must content myself with observing, that Mr. Holm's observations verify my ideas respecting the agency of electricity in producing pestilence and extremes in the seasons. On this theory not only pestilence, but severe cold, and extreme heat, hail, and snow, are all familiarly explained, and their connection with volcanic eruptions and other electrical operations, visible and invisible, demonstrated.

Barolin

Year.	D.	M.	Y.	D.	M.	Y.
1710	10	10	10	10	10	10
1711	11	11	11	11	11	11
1712	12	12	12	12	12	12
1713	13	13	13	13	13	13
1714	14	14	14	14	14	14
1715	15	15	15	15	15	15
1716	16	16	16	16	16	16
1717	17	17	17	17	17	17
1718	18	18	18	18	18	18
1719	19	19	19	19	19	19
1720	20	20	20	20	20	20
1721	21	21	21	21	21	21
1722	22	22	22	22	22	22
1723	23	23	23	23	23	23
1724	24	24	24	24	24	24
1725	25	25	25	25	25	25
1726	26	26	26	26	26	26
1727	27	27	27	27	27	27
1728	28	28	28	28	28	28
1729	29	29	29	29	29	29
1730	30	30	30	30	30	30

SECTION XI.

Pestilential Periods, exhibited by Means of an Increase of Mortality in distant Parts of the World.

AS there are certain periods when particular epidemics prevail over the world, or over a hemisphere, and when all other diseases assume peculiar malignancy, I have here subjoined a number of bills of mortality for different and distant places, to shew the effect of the general principle of disease in remote countries or towns. Some of these periods appear in the foregoing tables, as that between 1623 and 1627, and between 1631 and 1637.

A similar period occurred between 1718 and 1721.

Burials in

A.D.	London.	Amsterdam.	Vienna.	Breslau.
1716	24436	7078		
1717	23446	7451	5205	1458
1718	26523	8644	6110	1255
1719	28347	9726		
1720	25454	7820	6825	1816
1721	26142	7632	6490	1482

The plague raged in Turkey and Syria in 1718, 19, and 20, also at Marseilles in 1720; in which years, or one of them, the bills of mortality were swelled even in the north of Europe. I regret that some of the bills are deficient.

The

The period from 1725 to 1732 is equally remarkable.

<i>Burials in</i>			
A.D.	London.	Amsterdam	Dublin.
1725	25523		
1726	29647	9275	2763
1727	28418	13775	2946
1728	27810	11164	
1729	29722	9618	3206
1730	26761		2184

Health. { Plague in Egypt and the Levant during this period.

From 1739 to 1743.

<i>Burials in</i>					
A.D.	London.	Amsterdam.	Dublin.	Boston.	Church in Philadelphia.
1739	25432	7566	2201	554	97
1740	30810	10066		704	98
1741	32169	9864	2790	555	162
1742	27483		2320	517	123
1743	25200		2193	620	116

Plague in Levant, Italy, and America.

From the year 1744 to 1757 there were many sickly years; but no one distinct period when an increase of mortality is observable in all parts of the world at the same time.

From

From 1758 to 1764.

Burials in

A.D.	London.	Amsterdam.	Dublin.	Boston.	Church in Philadelphia.
1758	17526		1558	524	129
1759	19604		1752	629	271
1760	19830	7700	1993	576	174
1761	21063	7720	2292	456	144
1762	26326	8412	2490	531	200
1763	26143	9876*	2605	407	180
1764	23202	8585	2307	548	138
1765	23230	7725	2275	560	186

Plague in Egypt
and the Levant from
1758 to 1763. Yellow
fever in Philadelphia
in 1762.

From 1770 to 1773.

Burials in

A.D.	London.	Paris.	Amsterdam.	Boston.	Church in Philadelphia.
1770	22434	18719		483	127
1771	21770	18941	7983	482	139
1772	26053	20374	10609	517	157
1773	21656	18518†		595	179
1774	20884			596	161

Plague raging in the
east.

The series of epidemics in this period, measles, influenza, and sore throat, were followed by

* This bill is stated in the Annual Register at 10,506.

† In Anderson's History of Commerce continued, vol. v, 228, the number of deaths in Paris in 1773 is stated to have been 28,518.

dysentery

dyfentery in America from 1775 to 1777 inclusive, the mortality of which will appear from the following bills:

Burials in

A.D.	A Church, Philadelphia.	Hartford.	Litchfield.	Trinity-church, Boston.	Total.
1774	161	31	27	24	243
1775	156	74	31	48	309
1776	180	79	82	30	371
1777	222	72	120	48	462
1778	183	58	32	63	336
1779	142	49	34	35	260

It is probable the mortality in the Northern States of America was every where in that proportion. The same disease made similar ravages between 1749 and 1753—in 1759, 1765 and 6—in some places in 1769. It was remarkably mortal in 1773. This latter year was in America unhealthy. In Salem, Massachusetts, the bill of 1773 was raised to 208 (double the usual amount) by the dyfentery. The bill for St. Petersburg, in Russia, was swelled in 1773 one-fifth, and in 1777 one-fourth.

The last epidemic period, save one, was from 1781 to 1786 inclusive. The diseases were influenza, measles, and scarlatina. These were, in general, lighter than usual. In the interior

of

of New York State, Vermont, Massachusetts, and New Hampshire, the scarlatina was more severe and mortal; but on the sea-board, and especially in Connecticut, it was milder, and many places wholly escaped it. Yet every where the bills of mortality were swelled in 1783, 4, 5, or 6, when the plague was raging in the Levant and Egypt. This period was closed by remarkably cool summers, and no dysentery, or pestilential fever of any considerable violence or extent, succeeded.

Burials in

A.D.	Episcop. church, Philadelphia.	Boston.	Trinity-church, Connecticut.	Hartford, Connecticut.	Wethersfield.	Litchfield.	Guilford.	North-haven.	Total.
1779	142	35	49	25	34	17	11	303	Health.
1780	155	44	36	17	24	25	10	311	Health.
1781	179	41	37	20	35	17	15	344	Influenza.
1782	198	39	34	31	34	18	9	363	Ditto in Europe.
1783	232	56	42	46	42	19	8	445	Measles and angina.
1784	230	61	33	31	34	22	15	426	Ditto.
1785	166	41	44	24	30	18	6	329	Angina.
1786	156	49	50	37	36	19	9	356	Ditto.
1787	147	32	37	19	34	24	8	301	Health.

The scarlatina and measles produced their principal effects, it will be observed, in Philadelphia and Boston. The plague raged in Egypt principally in 1783 and 4; and the scarlatina appeared in Britain, but without very considerable mortality.

Laft

Last epidemic period from 1789 to 1797 inclusive.

Burials in					
A.D.	Philadelphia.	Episcopal church, New York.	Presbyterian church, New York.	German Lutheran church, New York.	Total.
1789	1027	337	109	59	1532
1790	888	310	107	52	1357
1791	1290	257	84	60	1691
1792	1497	404	121	66	2088
1793	5304	467	101	76	5948
1794	1135	413	71	71	1690
1795	2274	554	137	71	3040
1796	1602	540	186	62	2390
1797	1689	399	130	51	2269

Measles and influenza.
Influenza.
Fever began in New York.
Scarl. began. Pla. in Egypt.
Scarlatina—pestilence.
Some Fevers. Temp. summer.
Pestilence. Hot and humid.
Pestilence—New York.
Ditto—Phila. Cool summ.

The results above are not perfectly accurate, for the bills in Philadelphia, it is understood, are from August to August; those in New York commence with the year.—The bill of the presbyterian church in New York, for 1797, is by estimate; the others are taken from registers.

View of this epidemic period in Connecticut.

	Total.		
A.D.	1789	1790	1791
Orford—Derby.	21	18	17
New London.	58	81	60
Southington.	17	24	12
Corwall.	6	10	8
North Haven.	10	10	7
Wethersfield.	35	36	40
Litchfield.	33	41	37
Guilford.	20	21	23
New Haven city.	51*	50*	51
Two Societies, Hartford.	48	38	41
	299	341	270
	Measles—influenza.		
	Influenza.		
	Health.		
	Health.		
	Scarlatina.		
	Ditto and fever.		
	Dysentery.		
	Measles.		
	Healthy.		

* It will be observed, that the principal effect of the epidemics was in 1794, except in Litchfield, in the western part of the State.—Note, the number of deaths in New Haven for 1789, 90, and 91, is set down by ESTIMATE, the other bills are from registers.

View of the same period in Boston and the neighbourhood.

	Total.		
A.D.	1789	1790	1791
Charlestown.	22	35	26
Salem.	192	203	148
Stone chapel.	10	14	16
Trinity church.	50	31	60
Late Dr. Belknap's.	10	8	11
Dr. Elliot's.	37	40	46
Dr. Lathrop's church.	52	37	43
	310	397	300
	Catarrh.		
	Ditto—measles.		
	Health.		
	Ditto, except small-pox.		
	Ditto.		
	Ditto.		
	Scarlatina.		
	Ditto—fever.		
	Health.		

Let it be noted, that the effect of the scarlatina was here in 1795 and 96. The progress of the disease is distinctly marked to be from New York eastward, from 1793 to 1796. The scarlatina in 1785 and 6 was most severe in Massachusetts—that in 1794 in Connecticut. The bills in Boston for 1792 were swelled by the small-pox by inoculation, which is not to be taken into this account of epidemics. The year selected was rather unfavourable, as the condition of the atmosphere was inflammatory, and inclined to produce eruptive complaints. The scarlatina was then making its appearance in the Middle States. The spring of 1793, when inoculation was begun at Hartford, was still more unfavourable; and the small-pox was so unmanageable as to surprize the faculty. The principles unfolded in this treatise will solve the difficulty.

By a bill of mortality for Madeira, it appears that the pestilential principle of the years from 1760 to 64 extended to that healthy island.

1759	—	—	1136
1760	—	—	1356
1761	—	—	1746
1762	—	—	1366
1763	—	—	1118
1764	—	—	1325
1765	—	—	1267
1766	—	—	1037

The

The following bills for several religious societies in Connecticut will exhibit a general view of epidemics from the year 1750.

Burials in

A.D.	Guilford, 1 society.	Hartford, 2 societies.	Litchfield, 1 society.	Middletown, 1 society.	New Haven, 1 society.	Waterbury, 1 society.	Corwall.
1750	19	64					
1751	65						
1752	28						
1753	25						
1754	15	29					
1755	22	20	21				
1756	46	33	16				
1757	17	32	28				
1758	17	30	12				
1759	20	36	15				
1760	20	48	28				
1761	18	36	24				
1762	18	42	16				
1763	18	34	22	24			
1764	28	36	16	22	13		
1765	15	42	25	25	19		
1766	12	24	22	35	17		
1767	20	46	17	29	20		
1768	21	34	22	26	15		
1769	43	17	31	30	21		
1770	14	27	19	27	31		
1771	10	34	18	41	15		
1772	17	32	35	38	18		
1773	35	33	36	38	19		
1774	13	32	36	39	42		
1775	29	31	27	30	21		
1776	32	74	31	63	21	59	10
1777	29	79	82	78	31	59	20
1778	21	72	120	42	14	40	21
1779	17	58	32	37	15	27	3
1780	25	49	34	19	21	25	13
1781	17	36	24	35	12	17	6
1782	18	37	35	37	15	20	16
		34	34	45	21	31	8
1783	19	42	42	70	12	46	17
1784	22	33	34	41	12	31	8
1785	18	44	30	40	17	24	5
1786	19	50	36	28	23	37	4
1787	24	37	34	26	20	19	20
1788	23	45	27	24	41	22	4
1789	20	48	33	44	14	35	6
1790	20	38	54	34	26	36	10
1791	21	41	41	30	12	20	6
1792	15	41	23	24	11	37	8
1793	29	65	80	35	12	40	10
1794	54	109	56	28	50	47	19
1795	55	88	35	16	38	34	9
1796	19	75	40	35	8	42	15
1797	25	59	40	25	14	18	8

Dysentery and angina for 3 or 4 years.

Anginas.
Anginas in some places.
Dysentery in many places.
Catarrh.
Measles.
Measles, dysentery, and fevers,

Influenza.
Plague, Philadelphia.

Dysentery in some places.

Angina and dysentery, measles.
Angina, measles.
Catarrh, angina.
Influenza and measles.
Measles, angina, and dysentery.

Angina and dysentery very fatal,

Influenza.
Influenza in Europe.
Measles. Angina began, but scarcely perceived by the burials in Connecticut.

Measles, influenza.
Measles, influenza.
Some fevers, but no epidemic.
Angina, fevers.
Angina, fevers.
Fevers.
Measles in many places,
Health in general.

From the bills of mortality and preceding history may be deduced some interesting observations.

1. We observe an order and progression in the epidemics, which is in a degree uniform. Periods of pestilence, with some exceptions, seem to be introduced by measles and influenza; then follow diseases of the throat, or anginas; lastly, pestilential fevers. During the whole period, the measles, influenza, and angina, occasionally appear in spring, autumn, and winter; and rarely, if ever, does a pestilential fever, as plague and yellow fever, occur in a particular city or country, without influenza, angina, measles, or inflammatory fevers, in the spring preceding, for immediate precursors. This is true in the tropical climates, in cases of epidemics; and so uniform has been the fact in temperate latitudes, that I am nearly prepared to say, that if none of those precursors appear in winter and spring, no pestilential fever will be epidemic in the following summer and autumn, unless the dysentery may be excepted. It holds true in every case of *great* pestilence.

2. The progressiveness in the pestilential principle is obvious in the augmented bills of mortality which immediately precede the plague. This arises from the number and violence of the malignant diseases which always precede an epidemic pestilence. This augmentation is

visible sometimes two years before the plague appears, and almost always in the spring months preceding. See the London bills in the years preceding the plague in 1625, 1636, 1665. The same is observable in other bills, both in Europe and America. In a few instances the bill of the preceding year is low; but in this some other epidemic has usually gone before, and finished its course, or the plague is preceded by influenza only, which does not swell the bill of mortality.

3. Sometimes a series of epidemics falls with more violence on one hemisphere than on the other; but, perhaps, in no instance has a course of diseases spread over one continent without showing themselves on the other. I have not been able to find an instance in which the plague has made great ravages in the east, except when the American continent has been more or less affected by the epidemics above-mentioned; and, in some instances, it is proved that the violence of the sore throat, influenza, measles, or yellow fever, in America, has corresponded with the violence of pestilence in Egypt and the Levant. The commencement of each period of epidemics is nearly contemporary in both hemispheres*.

* It sometimes happens that pestilence occurs in Constantinople, Smyrna, or Cairo, when it is not epidemic beyond those cities, owing to peculiar seasons and local causes.

But

Thus a great plague in Constantinople was contemporary with the fatal angina and dysentery in America in 1751—also in 1755. Contemporary with the measles in America, in 1758 and 9, was the commencement of the extensive Levant plague of 1760. Pestilence in Persia was contemporary with the epidemics of 1773. In 1783 commenced plague in the east, and epidemics in America. The same in 1792 and 3.—Diseases of the throat, in almost every instance, prevail at the same time in Europe and America.

4. In two periods within half a century a severe angina and dysentery have been epidemic together, and once for a series of years, as in 1751, and from 1773 to 1777. This is an exception to the usual order, and other deviations sometimes occur.

5. As catarrh precedes, so it follows every severe epidemic pestilence; and the persons who have been affected with a pestilential fever in summer are more apt to be affected by catarrh at the commencement of cold weather.

6. After some pestilential fevers in summer, the inflammatory fevers of winter wear the

But it never spreads to Syria, the islands of the Archipelago, and other neighbouring countries, except when epidemic diseases spread over the world; at least, I have not found an instance.

livery of the summer fevers. They generally carry with them bilious discharges and a yellow skin. They have also this remarkable character, that they speedily run through the inflammatory diathesis, and become typhus. They are the *pestilence of winter*; and sometimes appear *before the pestilence of summer*. This fact alone decides the question, that pestilential fevers of summer are generated on the spot where they exist, and derive their malignant and infectious quality solely from the state of the elements.

This species of inflammatory fever has occurred in many cases, during the winter months, since the year 1790. In some cases it has extinguished three, four, and five members of a family, as in Hartford and New Haven. But it is a most consoling reflection, that it is less frequent than formerly in this country. It has not been epidemic in the northern states since 1761, as far as I can learn. Formerly it was as frightful a calamity as the yellow fever is in this age. In the foregoing history many examples have been mentioned—as at Fairfeild in 1698—at Waterbury in 1713—at Hartford and Duck Creek in 1720—at Farmington in 1729—at Bethlem, Hartford, East Haven, and New Haven, in 1761—at Holliston in 1753, &c. —Whether the disappearance of this disease is owing

owing to the clearing of the country, by which the quantity of debilitating miasmata of summer has been diminished, or whether it is the consequence of other alterations in our climate, is not easily determined.

The disappearance of the long fever, so called, is another most consoling circumstance. This species of typhus fever was formerly one of the most terrible diseases of our climate. At present it is a rare occurrence.

On the whole, we have very clear proof that the *quantity of disease* in this country has been diminished within half a century. The yellow fever, that is, the pestilential fever of summer and autumn, was formerly as frequent, and as malignant, as in this age; while the inflammatory fevers of winter, and the long fever, have almost disappeared as epidemics. The intermittents and remittents of autumn are greatly decreased in the northern states; and the dysentery has not increased in frequency or virulence. Anginas have never been so fatal as they were between 1735 and 1743.

It is probable that some of these changes in the character of diseases may be ascribed to alterations in our climate, or modes of living, and therefore may be permanent. In some cases, improvements in medical science and the practice of physic may have disarmed dis-

eases of their terrors. But it is possible that some of the changes mentioned are only revolutions in disease, occasioned by temporary causes; and that the same disorders may, in future periods, recur, with the whole train of formidable symptoms,

SECTION XII.

Of the Influenza or Epidemic Catarrh.

AS the catarrh appears to be the disease which is most closely connected with pestilence, and the least dependent on local causes, or the sensible qualities of the air, I have collected all the well defined instances of this epidemic which have occurred to my researches, and arranged them in chronological order; placing against the year the most remarkable physical occurrences, and mentioning those which fell within the years next preceding and following.

Catarrh epidemic in

A. D.

1174. The year *before* an eruption of Etna, and followed by great mortality.

[Chasm in our accounts of this disease.]

1510. The *same* year with an eruption in Iceland, and after great earthquakes; the air humid; a comet the next year.

[Chasm.]

1551. The year *after* an eruption of Etna and a comet. Season wet.

1557. The year *after* an eruption of Etna. Season mostly wet, but in some countries dry. A comet the same year.

[Chasm.]

1580. The year *after* an eruption of Etna. Cool, dry, north wind. A comet.

1587. The *same* year with an eruption in Iceland, and year *after* a comet.

1591. The year *after* great earthquakes and a comet.

1597. The year *after* great earthquakes and a hard winter. A comet the same year.

1602. The year *after* earthquakes, an eruption in South America, and a severe winter. Cool, wet season.

1610. The year *after* an eruption of Etna; a comet and a severe winter. Season very hot and dry.

[Chasm.]

1647. First catarrh mentioned in American Annals. A comet and violent earthquakes in South America.

1650. In Europe, the *same* year with an eruption of Etna and earthquakes.

1655. In America, the *same* year with great earthquakes in South America, and an eruption of Vesuvius.

1658. In Europe *after* a severe winter. Summer cool.

1675,

1675. In Europe, while Etna was in explosion.
Mild winter.
- 1679-80. In Europe, at the close of 15 years
eruption of Etna. Wet season and a
comet.
1688. In Europe, the *same* year with an erup-
tion of Vesuvius after a severe winter,
and earthquakes; began in a hot sum-
mer.
1693. In Europe, the *same* year with an erup-
tion in Iceland, and great earthquakes.
Cool summer.
- 1697-8. } In America, after a great earthquake
 } in Peru. A comet and severe winter.
1699. } In Europe, the *same* year with great
 } earthquakes and a comet.
- 1708-9. In Europe, the year *after* a comet and
volcanic eruption; in a severe winter.
1712. In Europe, the *same* year with an erup-
tion of Vesuvius, and a comet. A wet
season.
1717. In Europe, the year of a comet, an erup-
tion of Vesuvius and a severe winter.
1729. In Europe, the *same* year with an erup-
tion in Iceland and of Vesuvius. A
dry summer. A comet.
1733. Universal, after a cold winter, a comet
and great earthquakes.
1737. Universal, the *same* year with an erup-
tion

tion of Vesuvius; great earthquakes and a comet.

1743. } In Europe, violent earthquakes.

1744. } A comet; earthquakes.

1755. In Europe, in the *same* year with violent earthquakes, and eruptions of volcanoes. Severe winter in Europe.

1757. } In America, soon after a comet, and followed by an earthquake.

1758. } In Europe, with a meteor; earthquakes the next year.

1761. } In America; an earthquake at the same time.

1762. } In Europe; a comet the same year, followed by an eruption of Etna the next year. Dry summer in America.

1767. In Europe, the *same* year with an eruption of Vesuvius; and the year after other eruptions and earthquakes.

1771. } In America, in the years with volcanic

1772. } eruptions. Cold winter in 1772.

1775. In Europe, preceded by earthquakes; small eruption of Lipari the *same* year, and in New Spain.

1781. } In America, the year *after* an eruption of Etna, and a most rigorous winter.

1782. } In Europe and Asia; cold summer; very dry in America; the year *before* a great eruption of Heckla.

1788.

1788. } In Europe, soon *after* eruptions of Vesuvius and Etna. A comet.
1789. } In America, contemporary with an eruption of Vesuvius; just after great earthquakes in Europe and Iceland, and a hot summer.
1790. In America, after a mild winter.
1795. In Europe, the winter *after* a great eruption of Vesuvius.
1797. In Europe, the *same* year with a comet and earthquakes.

The accounts of the seasons are mostly from English writers, and refer to England, with some exceptions. In regard to heat and cold, the seasons are generally uniform in most countries on the same continent, but not in regard to drought or moisture.

Of these forty-four instances of influenza, it may be observed from the preceding history,

- 1st. That most of them happened after or during severe cold, or during moist weather, and in spring, winter, or autumn. Some, however, happened in dry, hot seasons; and others in mild winters.
- 2d. Eighteen instances occurred in years when there was a volcanic eruption in Italy or Iceland; and eleven others, though in different years, were within a few months of eruptions; making twenty-nine out of the forty-four.

3d.

3d. Almost all happened in years of great earthquakes, or within a few months preceding or following them.

4th. Twenty-nine instances occurred within a year, or a few months preceding or following the approach of comets.

It is further to be observed, that some of these epidemics have been limited to the American hemisphere, at the distance of three, four, or five years from an epidemic of the same kind in Europe. Such as those of 1647, 1655, which coincide in time with violent earthquakes in South America.

In other instances, this epidemic spreads over the whole globe, usually beginning in America, according to the information yet obtained. Thus, in four instances, viz. 1698, 1757, 1761, 1781, it spread over the American hemisphere one year prior to its invading the other hemisphere; and the universal catarrh of 1733, which encircled the globe, commenced in America two months before it did in Europe. The epidemic of 1782, invaded Europe, from the side of Asia, the year after it appeared in America. The influenza of 1788 in Europe, *preceded* the same disease in America—the only instance I have found.

I regret my want of materials to complete a view of this subject. No regular register has been kept in America of the seasons, diseases, and

and phenomena, from the first settlement; and, whether any notices of all the catarrhs in this country are in existence, I do not know. I have found no account of any between 1655 and 1698; nor between the latter year and 1733. From 1737 to 1757 is also a chasm. One of these instances, that of 1698, came to my knowledge by accident, as I have mentioned under that year in the foregoing history. From the uniform appearance of this epidemic, as often as once in ten years, in periods of which we have correct registers, we have grounds to presume it has always occurred in nearly the same periods.

This epidemic is evidently the effect of some insensible qualities of the atmosphere; as it spreads with astonishing rapidity, over land and sea, uncontrolled by heat or cold, drought or moisture. From these circumstances, and its near coincidence in time with the violent action of fire in earthquakes and volcanic discharges, there is reason to conclude the disease to be the effect of some access of stimulant powers to the atmosphere by means of the electrical principle. No other principle in creation, which has yet come under the cognizance of the human mind, seems adequate to the same effects. I do not consider the earthquakes and volcanic eruptions as the *causes* of this epidemic,

mic, but as *effects* of the common cause and evidences of its existence.

The courses of this epidemic are very various. That in 1510 proceeded from Africa to Sicily, Italy, and the north of Europe. That epidemic could not be the effect of the eruption in Iceland, for it appeared first in southern latitudes. If there was a volcanic discharge, about that time in Africa, we might be led to ascribe the disease to that cause; but it is more probable that we ought to ascribe it to an insensible operation of atmospheric fire*, which is more general and violent about the time of eruptions; and which fire is probably agitated in all parts of the globe, although it produces visible explosions only in particular places. I think no man can question the fact, after reading the preceding history.

The course of the epidemic catarrh of 1551, I am not able to ascertain; nor that of 1557; but the latter invaded Spain in August.

The severe influenza of 1580, began in the south of Europe in the heat of summer, and proceeded to the north. The season, in general, was temperate.

* I use this word to express the principle manifested in electrical operations, although this is usually supposed to be a cold fusion, or substance destitute of heat. Of the nature of this principle we know little, and this only by its effects.

From

From that year to 1708-9, I find no account of the course of the epidemic catarrh; but the latter began in the north of Europe, and proceeded to the south.

The epidemic of 1729-30, proceeded from Poland and Silesia to the west and south of Europe, and ended about the time of an explosion from Vesuvius.

The universal catarrh of 1733, began in America in the autumn of 1732. It appeared in Europe in December. That of 1788 appeared at different places in April, May, June, and August.

The epidemic in America in 1789, began in the middle state, and spread southward and eastward. In 1790, it began in about the same longitude, but in the interior country, and spread eastward and southward.

The influenza of 1782 in Europe, came from Asia, possibly it might have travelled from America, across the Pacific to China and Kamschatka, as it was epidemic in America in 1781.

This is all I am able to discover of the origin and direction of this singular epidemic. It is greatly to be desired, that we might learn precisely the dates of its appearance, the place, the direction of its progress, in all cases, and compare these circumstances with the extraordinary agitations of the elements, which oc-

cur about the same time. But for this purpose, my materials are incomplete.

It is observable, however, that the influenza is closely allied to the measles. Sometimes, the symptoms are combined in the same attacks; and rarely does one disease become epidemic, except just before or after the other. This proves their alliance; indeed, I consider them as different modifications of the same epidemic.

Catarrh is also closely connected with pestilential fevers, and, sometimes, this is true of the measles. It is rare, indeed, that epidemic plague and yellow fever do not begin and end in catarrhal affections; that is, catarrh precedes in spring, and follows in autumn. Sometimes, pestilence is preceded and followed by measles and angina.

Every epidemic constitution seems to commence with measles or influenza. To these succeed angina, in some of its various forms, which are all the offspring of the same parent. Then follow pestilential fevers, in the form of dysentery, yellow fever and plague. Whenever the epidemic constitution is manifested by measles, influenza and affections of the throat, common diseases, even in places apparently healthy, become more malignant; and sporadic cases of pestilential fever occur in almost every situation.

It

It is remarkable, that the extent and violence of the influenza mark very nearly the severity of the pestilential fevers which precede and are to follow it. The two epidemics of 1733 and 37, invaded the whole globe in the same year; they were very severe, and so were the anginas and plagues of that period; beyond what has occurred at any other time during this century.

Since finishing the foregoing history, I have learnt some further particulars respecting the catarrh of 1737. From two elderly gentlemen, who were then arrived to adult years, I learn that this influenza invaded Connecticut in the month of November. If this is correct information, the disease appeared in the two hemispheres about the same time, an exception to the usual order of the epidemic.

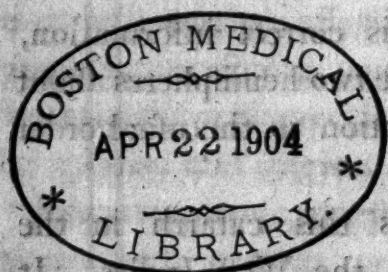
Dr. Warren mentions this catarrh in the winter of that year, in the West Indies. It was the *immediate precursor* of the violent fever in Barbadoes in 1738, which that author has described, and if I do not mis-remember, has *imported* into that island!! It was also the immediate precursor of that pestilential fever which, in the same summer, threatened Mexico with depopulation.

This epidemic was so severe, general, and sudden, in its invasion, that neighbours, in Connecticut, could not visit each other; and it

left in health scarcely people enough to perform the ordinary domestic labours necessary to support life.

It will be observed, that this epidemic coincides in time with a great eruption of Vesuvius, and one of the most tremendous gales in the East Indies recorded in history.

Short mentions universal catarrh in Europe in 1747, but not severe. This corresponds with an eruption of Etna. See vol. ii, 164, 321.



SECTION XIII.

*Of the Order, Connection, and Progression, of
pestilential Epidemics.*

IN the early periods of the world, little notice appears to have been taken of a connection between epidemic diseases; nor have modern writers supplied this defect in the history of medicine. Hippocrates and Sydenham seem to have been aware of such a connection; and the latter author has laid a broad and firm foundation for a complete system of truth on the subject of epidemics. His observations were confined to the city of London. Had he extended his view to all parts of Europe, and generalized his observations, he would have found a multitude of facts to justify his theory; and probably would have raised it above the reach of that obloquy and ridicule which succeeding professors of physic of less genius and learning have cast on his occult qualities of air.

Indeed, it is surprizing that medical men have not pursued the ideas suggested by these

great fathers of their science. Hippocrates led the way, unlocking the great doctrine of a constitution or state of the atmosphere, calculated to produce particular epidemic diseases; a doctrine which Sydenham has pursued with wonderful success. Any man who reads the history of diseases, must see that certain species of them appear nearly together in time and place. The order in which they appear may not be exactly the same at all times, and in all countries; but they occur so nearly together as evidently to prove their alliance, and their dependence on the same general causes.

All popular diseases must have for their causes some principles as extensive as the effects. These causes, most probably, exist in the elements, fire, air, and water; for we know of no other medium by which diseases can be communicated to whole communities of people.

Bad food, indeed, is a fruitful source of diseases; but this must always proceed from the qualities of the elements which enter into its composition. A defect, therefore, in the nourishing powers of food, is a consequence of a defect or superabundance in the elements, or in their combination in animal and vegetable productions. It may be considered as a disease in the animal and vegetable kingdom, which most probably proceeds from the same causes as epidemic distempers among mankind.

The

The principal epidemic distempers which invade mankind are catarrh or influenza, measles, whooping or chin-cough, the different species of angina, small-pox, bilious fevers, petechial fever, dysentery, plague. Of these, catarrh is the most decidedly an epidemic, dependent wholly on a particular state of atmosphere. Cullen calls it "catarrh from contagion," to distinguish it from sporadic cases of the same disease; but, after careful observation, during the progress of it in the United States in 1789, and again in 1790, I am confident the progress of the disease depends very little on a communication from person to person. It is doubtful whether it is an infectious disease; and I have strong evidence to prove it not so; but certain it is, that its sudden invasion of whole families, whole towns, and even whole countries, and the rapidity of its progress over sea and land, absolutely preclude the supposition of its dependence on specific contagion.

The other diseases above enumerated may arise from both causes—infection, and a peculiar state of air. Some of them depend mostly on a constitution of air fitted to produce them; others are seldom produced without a connection with diseased persons. It is, however, proper to observe, that the small-pox, dysentery, and plague, are not usually, and in strictness of language, *epidemic* diseases. They seldom

invade whole countries. They are more properly *endemic*; yet this epithet is not strictly applicable to them, being used more properly to denote a disease which is *peculiar* to a particular place, whereas those diseases may invade any place on the globe. The elephantiasis is an *endemic* in Egypt, and certain other places in warm climates; the small-pox, dysentery, and plague, usually appear in cities, camps, or other unhealthy situations, without affecting neighbouring places which contain not the same local causes of disease. They might, therefore, in strict propriety, be denominated *temporary endemics*, in opposition to *epidemics* which spread to all places alike; and to *endemics*, which *constantly* or *usually* appear in particular parts of the world.

This distinction, however, is not very material; and I shall therefore speak of the small-pox, dysentery, and plague, as *epidemic* diseases; meaning by this epithet, that they, at certain times, spread generally over a particular town or region.

The nature and kinds of contagion will be more particularly considered in a subsequent section; the present subject is the order, connection, and progression, observable in pestilential epidemics.

The influence of a certain state of air in generating epidemics was observed by Hippocrates, who

who has described the prevalent diseases in different seasons. In his second section on epidemics he describes what he calls "katastasis loimodes," a pestilential state of the air or seasons. He does not, indeed, in this passage mention the *plague*; but he speaks of those malignant diseases which are, in modern times, the precursors of the plague, and which are now produced by the state of weather which he describes.

This state of the seasons he represents thus—

"The year was austrinus, remarkable for southerly breezes, rainy, and without winds. The first part of the year dry, and autumn rainy, with southerly winds, humid, and cloudy. In winter, southerly winds, moist and mild weather. About the vernal equinox, severe cold; but the north winds, with snow, were of no long duration. Spring was again calm; southerly weather; great rains continued till August, then clear hot weather: the cool Etesian winds blew but little, and for short periods; a rainy autumn, with north winds."

The southerly, hot, humid air here described, whenever of long continuance in summer, proves the cause of numerous malignant diseases in the United States, as well as in Europe, although not certainly productive of pestilence.

Hippocrates proceeds to mention the diseases which prevailed in this state of seasons. "Before spring, even during the cold weather, ap-

peared many erysipelous diseases of a malignant type. Diseases of the fauces, accompanied with hoarseness; ardent fevers, with phrenitis; ulcers in the mouth, inflammation of eyes, carbuncles, &c. These diseases spread and became epidemic." The author then proceeds to describe the erysipelas and other diseases here named. These cases differ from the plague in Athens; and prove that the pestilence in Thasus, where he wrote, was of milder symptoms, though probably contemporary with that epidemic in Athens.

My particular reason for reciting these passages from Hippocrates is, to prove a progressiveness in a pestilential state of air, and the diseases which it produces. The diseases here mentioned are the same, substantially, as those which precede the plague in modern times, in the countries bordering on the Mediterranean, and with little variation, the same with those which precede the plague in all parts of the world. Erysipelous, or other eruptive diseases, catarrhus affections, or ardent fevers, are the constant precursors of the plague wherever it appears. Hippocrates does not mention any fatal plague in the state of air described; and it often happens, at this day, that the strength of the pestilential principle is arrested in its progress, and the epidemics are limited, in their violence, to diseases of a type less malignant

nant than the true plague, or arising to the plague only in a few scattering cases. But whatever may be the degree of the pestilential state of the air, or at whatever point it may be destined to cease, and yield to a more salubrious constitution, the class of diseases which mark its rise and progress, are always similar, or the same, modified only in the violence of their symptoms by accidental circumstances.

A careful attention to these facts cannot fail to convince the observer of the justness of Sydenham's doctrines in regard to constitutions of air; and the facts themselves demolish, at one stroke, all the common medical doctrines of the communication of pestilence from place to place by contagion or fœmites.

Unfortunately, the histories of ancient plagues furnish but little light on this subject; yet the barren annals of antiquity and the middle ages are not wholly destitute of evidence to this point. The progression of the plague in Rome, which grew more general and fatal to the second and third year, is a fact recorded by Livy, and is related in the preceding pages.

The remark of Dion Cassius, that the ashes from Vesuvius, in the great eruption of 79, produced that year only slight diseases, but the next year an epidemic, has already been noticed. It leaves us no room to question, that the destructive plague of the year 80 was preceded

preceded by epidemic disorders of a less malignant type.

The middle ages furnish facts in confirmation of this doctrine. Witness the great plague in 1112, which was preceded by erysipelous diseases in England in 1109, and great mortality in 1111: the plague of 1242, which was preceded by great mortality in 1240. The same fact is observable in the pestilence of 1252, 1368, 1379, 1390, 1517, 1527, 1575, 1636, and in many other instances.

This fact did not escape the notice of that accurate observer of nature, Lord Bacon, who lived at a period when the plague frequently infested England. He says, "The lesser infections of the small-pox, purple fever, agues, &c. in the preceding summer, and hovering all the winter, *portend a great pestilence the following summer*, for putrefaction rises not to its height at once."

Works, vol. iii. page 59.

That state of air which produces pestilential diseases, Lord Bacon denominates *putrefaction*; but whatever appellation we may give to the *cause* of pestilence, the remark is demonstrably well founded, that this "rises not to its height at once." It is progressive; producing first the "lesser infections." The plague is rarely, if ever, an original, distinct, isolated disease; but
the

the last, or most mortal form of a series of malignant distempers. The *purple* fever, mentioned by Lord Bacon, is nearly allied to the *petechial* fever, which is the usual precursor of pestilence in the Levant.

The universal plague of 1635, 6, and 7, was preceded by the usual diseases, and the progress of them is distinctly traced by the learned Diemerbroeck. He remarks, Chapter 3, *de peste*, that "the spring of 1635, was warm and moderately humid, to which succeeded a very hot, dry season, in which appeared many malignant epidemics. In the first place, a severe plague broke out at Leyden, and destroyed more than 20,000 lives. At Nimeguen, in Gueldres, and other regions, a certain pestilential fever spread with dreadful mortality. In autumn, the severe heat still continuing, with excessive drought, many other malignant diseases appeared, as small-pox, measles, diarrhoea, and dysentery, of a very bad type; but above all, the above-mentioned pestilential purple fever, called in Italy *petechial*, increased daily in extent and violence, until it turned into the true plague—" *donec tandem in apertissimam pestem transfret.*"—The author goes on to remark, that from November, through the winter, scattering cases of plague occurred in Nimeguen. In January 1636 it increased, and in March spread and became epidemic;

rose

rose to its height in April, and continued till October.

See pages 5 and 6.

This passage contains a number of important facts. First, The seasons were insalubrious. Secondly, The pestilential state of air extended to many places at the same time. In another page, the author says, the pestilence spread over almost all Germany and the Low Countries. Thirdly, This state of air was of different degrees of malignity or violence, in different places, at the same time: thus the plague appeared at Leyden early in 1635, but contemporary with this was the appearance of the purple fever in Nimeguen and in other places; and during the summer and autumn, this, and other epidemics, continued to rage with great mortality, and, at last, the strength of the pestilential principle increasing, the fever changed its form, and appeared in the true plague.

Now, the modern way of accounting for the plague in Nimeguen would be, to *allege* or *suppose* some infected goods to have conveyed the contagion from Leyden, where it first appeared; and then to suppose, the infection to be carried to Leyden from the Levant.

The philosophic Diemerbroeck, who was present and observed all the circumstances, *supposes* nothing. He relates plain facts just as they occurred,

occurred, and admits that the plague must have originated in the country.

By considering the malignant epidemics that prevailed at that time as connected, and depending on the same general cause, we solve all the difficulties attending the origin of the plague. The petechial fever, which appeared at Nimeguen and other places in 1635, was *one of the forms* in which the general contagion of the period exhibited its effects on the human constitution. It was a *part* of the pestilence—it could not be conveyed from Leyden, for it appeared in most parts of the Low Countries and in Germany at the same time. The same general cause, or indisposition in the elements to support healthy life, produced various pestilential diseases, according to place, season, age, habit of body, and constitution, until its strength and violence arose to their height, and gradually introduced the worst form of pestilence.

The idea of Diemerbroeck, that the purple fever “turned to the plague,” must give great offence to the followers of Mead and Cullen, the advocates for the doctrine of the propagation of the plague solely by specific contagion. It opposes, efficaciously, their whole theory, and levels it with the earth.

The fact is, however, indisputable. In the distressing period from 1569 to 1577, when
Europe

Europe was almost depopulated by the spotted fever, physicians observed that this disease frequently turned into the plague, and the plague into the spotted fever. The same fact was often noticed by writers of the 16th and 17th centuries, in which the plague frequently over-ran Europe. These two diseases are, therefore, two distinct forms or modifications of pestilence—probably bearing an affinity to each other, like that between the distinct and confluent small-pox. This fact shows, that the distinction made by medical writers, between *pestis* and *pestilentialia*, the plague and other pestilential distempers, however useful in practice, is not authorized by truth and philosophy. The ancients classed all contagious epidemics together, and denominated them *pestilence*: and this distribution, in regard to their causes and origin, was doubtless most philosophical. The distribution made by modern physicians seems to have arisen out of differences of symptoms, and to be best adapted to practice. At the same time, it has probably been the occasion of the common error of considering different species or forms of pestilence as diseases of general difference, and proceeding wholly from distinct causes, when, in fact, they all have *one general cause* in common, and the varieties of their symptoms proceed from *distinct, local, and temporary causes*.

On

On this subject the learned Riverius, in his *Praxeos Medicæ*, lib. 17, has many judicious remarks. He observes, "That authors, who write on fevers, distinguish a pestilent from a malignant fever: by pestilent fever they understand the true plague; by a malignant one, the fever vulgarly called *purple* or other fever, which, though epidemic and contagious, is less dangerous, and in which more patients survive than perish; whereas the essence of the true plague consists in this, that it destroys more than half who are seized with it." He, however, considers these fevers as differing mostly in degree of malignity, and therefore treats of them under one head.

A pestilent fever this author considers as not proceeding solely from intemperate heat or putridity, but from a malignant and poisonous quality; and whenever this quality appears in a fever, whether quotidian, hectic, or putrid, he thinks it ought to be denominated *pestilent*. A pestilent fever differs from the plague as species from genus, because there may be plague without fever.

This author remarks also the connection between certain epidemics. "Many deadly diseases accompany the prevalence of pestilence, as phrenitis, anginas, pleurifies, peripneumonies, inflammations of the liver, dysenteries, and many others." He ascribes epidemics to the state of

air

air as a common cause, to which he adds the usual local or particular causes, which modify its influence.

Prosper Alpinus informs us that these diseases prevail also in Egypt at certain times; but he gives no account of their order or connection.

Vol. ii. p. 73.

Bellinus describes the phenomena which precede the plague, which he calls its *antecedents*. After mentioning food of a bad quality, impure air from exhalations, intemperate seasons, vapours emitted during earthquakes, and the like, he says, "*Mox autem invasuram antecedunt morbi epidemici, qui cujuscunque generis esse possunt, febres petechiales, variolæ, morbilli, dysenteria, pleuritides epidemicæ.*"

De Febribus, page 265.

This author does not here speak of these antecedents as *unusual* phenomena; but lays it down as a general fact, that spotted fevers, small-pox, measles, &c. become epidemic just before the invasion of the plague.

Van Helmont observes, that "he could never perceive a different pulse in the plague from that in continual malignant fevers," p. 1138.—No inconsiderable authority for the identity of the diseases in kind, however various in degree.

The

The great Sydenham took notice of the unusual prevalence of malignant distempers just before the plague of 1665. In vol. i. p. 122, he says, "I never knew pleurifies, quinsies, and other inflammatory diseases, more common than they were for some weeks preceding the plague in London in 1665."—These were the hybernal and vernal precursors of pestilence. As the season advanced, and the weather became mild, these inflammatory diseases yielded to a malignant fever, described by the same author, and already mentioned in the preceding history, which was the immediate precursor of the true form of the plague, into which it changed by such insensible degrees, that Sydenham himself was at a loss to determine whether that fever was the plague or not, and was candid enough to acknowledge his ignorance. And as a further proof that this fever and the plague were only different forms of the same disease, we must notice the fact recorded by Sydenham, that when the plague in autumn began to abate, the same malignant fever re-appeared—see page 136—that is, the disease, by change of seasons, began to lose its glandular marks, and gradually to assume a less malignant type. Hodges mentions the same fact, and so does Morton.

In every instance of a severe plague, of which I can obtain a tolerably correct history, the disease has passed through a similar progression, and exhibited similar facts.

Thus in 1719, the year before the great plague in Marseilles, appeared a pestilential fever in that city, which, in some cases, produced buboes and carbuncles; that is, the plague actually began to appear six months before the arrival of the infection from Syria!

In Aleppo, the plague, which appeared in 1742, was *preceded* by an acute fever; and, after the disease abated in July, appeared diarrheas and dysentery of a malignant type, attended, in many cases, with petechiæ; and intermittents, which often proved fatal. These diseases, in their acute forms, prevailed also with the plague, which in this year was not severe, nor wholly the predominant epidemic.

This continued acute fever, and pleurifies, ran through the winter. In November appeared a few cases of the plague. Where the *infection* had been dormant, from July to November, the author of this account, Alexander Ruffel, has not informed us.

In the spring of 1743 the plague again appeared, and spread in the city; and at the usual time in summer subsided, being again succeeded by other acute disorders, which, by bleeding and purging, were formed into tertians, double tertians and quotidians.

Here again we have the same progression in the state of pestilence, which had been remarked by Hippocrates, Bacon, and Sydenham. During the
existence

existence of this pestilential constitution in Aleppo, all the ordinary diseases of the country assumed a more malignant type; or, as Sydenham remarked of the diseases which preceded the plague of 1665, they "differed from the same diseases in other years by new and unusual symptoms, which, in short, amounted to this, that they were all *more violent*."

See vol. i. page 20.

The diseases changed their form with the seasons—the acute fever preceding ran into plague, and plague ran into malignant dysentery, tertians, and other acute distempers.

Similar facts are observed in America. The plague has been preceded by acute diseases, as anginas, remittents of a bad type, &c. and followed by remittents, dysentery, and malignant pleurisy.

The dreadful plague at Messina in 1743, which destroyed two thirds of its inhabitants, was introduced by a malignant fever. One physician alone, out of thirty-three, pronounced it the plague; the others denied it, because the disease was not attended with glandular swellings.

A similar fever preceded the severe plague at Venice in 1576; and the same uncertainty at first embarrassed the physicians and magistracy.

The terrible pestilence at Naples in 1656 was announced by the usual herald of the disease, a malignant

malignant fever. One physician alone pronounced it the plague, and for his audacity was imprisoned by the Viceroy.

The extensive pestilence, which spread over all the Levant countries and islands from 1759 to 1763, was every where preceded by a similar increase of malignant diseases, and especially by the petechial fever, which appeared, at Aleppo, in the year next previous to the plague. Yet the author of this account, Patrick Ruffel, labours very gravely to trace the disease to Turks from Egypt, and their old clothes.

The uncertainty among physicians, at the commencement of a plague, with respect to the nature of the disorder, is a strong proof of the doctrine for which I contend. Van Helmont, Diemerbroeck, and others, have found it necessary to lay down rules, with a great degree of care and caution, to enable themselves to determine whether a malignant disease is the plague or not. Van Helmont observes, p. 1138, that he could perceive no difference in the pulse in plague and continual fevers of the malignant kind—that buboes in the groin, parotides, &c. are not unfrequently found in fevers free from plague, and sometimes spots and carbuncles.—“But,” says he, “if many of these appearances do concur, there is no difficulty in pronouncing it the plague, especially if they appear before or early after the fever.”

Diemerbroeck

Diemerbroeck declares, that no one symptom determines a disease to be the plague—neither fever, buboes, nor carbuncles, are essential to that disease, for it often passes off without either—many of its symptoms are common to that and other distempers: the existence of the disease, therefore, is to be determined by a view of all the circumstances; and one criterion, he remarks, is, the prevalence of the plague in neighbouring towns.

This last remark indicates that the author had observed the existence of pestilence in various places at the same time to be a common event.

The difficulty, at first, in ascertaining the existence of the plague, proceeds wholly from the progression in the series of diseases—the malignant fevers preceding gradually, increasing in violence, and changing their form.

It has been the same in the United States. The first cases of the bilious plague have occurred early in summer, usually in July, sometimes in June. These have not excited much alarm, for they have not usually proved infectious; and they have, therefore, been classed among the ordinary diseases of the hot season. This, however, has ever been a mistake; they were the less malignant forms of approaching pestilence; yet five or six weeks after their appearance, when the epidemic has showed itself in its formidable array, our

citizens have hunted out some vessel from southern climates, and palmed the evil on her seamen or cargo.

Van Swieten, Comment. vol. xvi. p. 3, remarks, "that the plague has sometimes lain concealed under the mask of other diseases. When the plague raged at Vienna, in 1713, it frequently assumed the appearance of a pleurisy, catarrh, or quinsey; but soon after broke out buboes and carbuncles, most certain signs of the plague, accompanied with the usual symptoms."

Here we observe the usual precursors and companions of the plague, and the progression of the pestilential principle.

Hippocrates has remarked the augmented violence of diseases in particular periods. He says, "There are times when almost all the diseases that occur are extremely malignant, and, in general, fatal; so that coughs, phthisis, angina, are all equally mortal." He assures us, "that the truth of his observations had been confirmed in countries very different from each other, and in a variety of seasons and climates."

See the passage cited in Zimmerman on Physic, p. 163.

We have multiplied proofs of the justness of these remarks. During the periods which I call *pestilential*, the common diseases of a country, as dysentery and intermittents, become more obstinate

stinate and mortal; and even the pleurisy and peripneumony acquire unusual violence. And it may not be improper to repeat an observation before made, that the malignant or epidemic pleurisy never appears, except during these pestilential periods. It precedes or follows, in winter, spring, or autumn, those summers alone when pestilence invades our cities. Such was the dreadful disease in America, in 1697—8, in 1761, and which has showed itself, in several towns, during the present pestilential constitution.

But a most satisfactory proof of the progressiveness in a pestilential state of air, and in the corresponding malignity of diseases, is found in the Bills of Mortality. Thus, before the London plague in 1625, the Bill of Mortality rose from 8 to 9000, the standard of health; to 11,000 in 1623; and to 12,000 in 1624. The appearance of pestilence was clearly announced two years before it appeared; and, as the time of its appearance drew near, the extension or malignity of the preceding fevers was greatly augmented; for in the year of the plague, almost nineteen thousand persons died of other diseases than the plague. As the plague usually prevails from June or July to November, and other diseases are mostly merged in it, almost all the deaths by common diseases must have been in the beginning of the year, from January to June or July. Now, eighteen thou-

and deaths in the six months preceding the plague, or even two-thirds of the number, mark a prodigious increase of mortality, *the common sign of approaching pestilence.*

In the pestilential period in London, from 1634 to 1636, the Bills of Mortality rose two years previous to the plague.

The last great plague, in 1665, was announced by unusual malignity in diseases four years before its appearance. In 1661, according to Sydenham, began a series of epidemics, which greatly swelled the list of burials. There was, however, some abatement in 1663; but in 1664, and the first five months of 1665, the mortality again increased with rapidity, till a dreadful pestilence laid waste the city.

A similar increase of mortality is observable in the Bills of Mortality for Augsburg, previous to the plague in 1628, and in 1635—in Dresden, in 1632 and 3—in Philadelphia, in 1793—in New York, in 1795—and in New London, in 1798.

It must, however, be observed, that the Bills of Mortality will not, in all cases, exhibit the augmented number and malignity of the disease which precede pestilence; for it sometimes happens that the year next preceding the plague is very healthy, and the malignancy in the distempers which mark the beginning of the pestilential state, do not appear till the winter or spring

Spring previous to the plague. In this case the augmented mortality falls within the year and the same bills, as the deaths by the plague. This was the case in Augsburg in the year 1535. In such cases there is an interval between the preceding epidemics and the plague; such as we have observed in the New England States between the influenza and the scarlet fever, and the latter disease and the yellow fever.

Monthly bills will exhibit the progress of pestilential epidemics with more accuracy.

Fernelius remarks, page 161, that "infection is to be perceived in the air when it produces fevers not pestilential, but which are at the threshold of pestilence;" plainly intimating that certain malignant diseases precede the plague. He speaks of the fact as general and well understood.

Even in the West Indies, the infectious yellow fever has its precursors. That fever in Barbadoes, in 1738, was preceded by catarrh and suffocating cough in 1737, and the spring of 1738. Yet authors pretend the disease to have been *imported* from Martinico!

See Warren and Short, vol. ii. 164.

The different modes in which pestilence invades mankind seem to depend on different causes. Sometimes the principal cause seems to be an essential

essential alteration in the invisible properties of the elements; in which case the diseases of a particular constitution, though somewhat modified in their symptoms, are not controlled or arrested by the seasons. On the contrary, the atmosphere continues to be pestilential, and to multiply disorders of a malignant type, through every variety of seasons and of weather. Thus we observe many instances of violent plagues in the most pleasant, and, to all appearance, the most salubrious seasons. Several instances have been mentioned in the preceding history, and we have demonstration of the fact in the United States. The present pestilential state commenced with the measles and catarrh of 1789—90. The summers of 1794 and of 1797 were apparently temperate and salubrious; yet, in both these summers, the plague renewed its ravages in some towns, though with less mortality than in the sultry and unhealthy summers of 1793, 95, and 98.

On the other hand, pestilence sometimes proceeds principally from excessively intemperate seasons, as in severe heat after a cold winter. In this case the pestilence may invade a city very suddenly, and without a regular augmentation of mortality from previous diseases; but, even in this case, the plague has its precursors, which appear at least a few weeks, if not two or three months, previous to its attack.

Thus

Thus the plague in Aleppo, in 1742, first showed itself in the suburbs in April; but was preceded by an acute fever in March. The bilious plague in Philadelphia, in 1793, according to Dr. Rush, was preceded by the influenza, scarlatina, and bilious remittents. The same disease, in 1797, appeared, in scattering cases, as early as June.

In New York the epidemic of 1795 was preceded by angina trachealis, with anomalous symptoms, some cases of obstinate dysentery, at a premature stage of summer, and by febrile complaints, accompanied with bilious evacuations. At a meeting of the Medical Society, early in July, these facts were mentioned, as denoting an uncommon state of air; and the Society came to a resolution to make particular observations on the diseases that might occur before their next meeting. But, in the interval, the crisis of the pestilence arrived, and removed all doubts.

See Dr. Bailey on the Epidemic of 1795, p. 55 & seq.

The severe pestilence of the year 1798, doubtless, owes its violence to a series of most intemperate weather—most excessive heat, following a long and severely cold winter. Yet this disease was preceded by premonitory signs, especially catarrhus fevers. Of all the disorders to which mankind are exposed, none seem to indicate a pestilential state of air with so much certainty as catarrhus

catarrhus affections: they almost always precede the plague, usually accompany it, and sometimes tread close upon its heels.

In addition to the numerous authorities already cited, in proof of the progression of pestilence, let me mention Stenkus, who, in speaking of the diseases of 1564—5, observes, that anginas, pleurifies, and peripneumonies, became epidemic:—abortions were frequent, pains in the joints, small-pox, and measles: “*Quos tanquam præcursores sequebatur epidemica lues, incredibili grassationis sevitia,*”—depopulating towns and country, in Turkey, Egypt, France, England, and Germany.

Observations, p. 748.

Stenkus remarked, that the plague followed the other epidemics, as *its precursors*.

The same author takes notice of a malignant angina in 1564, which often proved fatal in a few hours, like the plague. I mention this, because the learned Dr. Fothergill, and tribes of modern physicians who follow a celebrated name, have alleged that the *angina maligna* is a new disease, not known in Europe till about the year 1610, although it never was more fatal than in England in 1517.

In 1573 prevailed dysentery, measles, and purple fever; which, in 1574, says Stenkus, *changed into the plague*. His words are remarkable:—

“*Dudum*

“Dudum sane præfagiebat animus mihi, malignum hoc febrium genus, quod toto biennio Europæ partem non minimam peragravit, velut sparsis quibusdam præludiis, in pestem apertissimam transituram. Neque me adeo mea fefellit opinio.”—Observa. p. 761. This author foresaw the plague by means of its precursors.

“Eodem modo variolæ, morbilli, dysentericæ grassantes, sæpissime sunt præcursores internuncii pestis.” Epidemic small-pox, measles, and dysentery, are very often the forerunners of the plague.

Horstius, p. 253.

It is a common remark, that the reigning epidemic subdues all other diseases, or compels them to wear its livery. This remark, as a general one, is just; and is of no small weight in proving the connection between certain species of epidemics. In the spring of 1795 the measles prevailed in New York, but of a mild type. In August this disease disappeared, being completely merged in the bilious fever that spread from August to November. No sooner had the fever subsided than the measles re-appeared, and was of a less favourable type. This is a contagious disease; and yet how impotent was the contagion, in the instance related, under the all-controlling influence of the season and the elements. It disappeared in summer,

mer, in defiance of the powers of specific contagion, and was reproduced in autumn without its assistance.

This fact demonstrates that a general cause operated in the production of that disease; which general cause, in summer, was controlled by the heat of the season, and local causes in that city: these temporary and local causes operated during a particular time, and gave a different complexion to diseases. When they gave way, at the approach of winter, the general cause again assumed its empire, and reproduced the measles, which is a disease little affected by local causes.

But while local causes predominated in producing bilious plague, the general cause was not altogether inefficient; no bilious pestilence ever becoming epidemic and infectious, but under the influence of a pestilential constitution.

A fact related in Fairfield's Diary relative to the small-pox in Boston, in 1702, is very much in point.

This disease appeared in June, and gave much alarm; but proved of a mild type, and none died of it for several weeks. It continued to be favourable till September, when it assumed a more formidable aspect, being attended with what the writer calls a scarlet fever. The season was excessively dry. In December the scarlet fever abated; but the small-pox continued to be very mortal

mortal till the following spring. These facts are related by an unlettered, observing man; but they are evidence of a progressiveness in the disease. The efflorescence that accompanied the disease from September to December was only a particular malignant symptom, or modification, of the small-pox, produced by season, or other temporary cause.

The measles often exhibits a similar progression. This circumstance explains the difficulties mentioned by medical writers. Dr. Rush mentions the circumstance of persons in 1789, who had a fever, cough, and all the symptoms of measles, except a general eruption. Some had a trifling efflorescence about the neck and breast. The same happened in 1773 and 1783, vol. ii. 238. The fact is also mentioned in Edinburgh Medical Essays, vol. v. Persons thus affected, have the measles months or years afterwards. This lighter species of the measles is produced by the same general cause which produces the disease in full force; but the constitution, at that time, resists the further operation of the cause. At a future time, the cause will produce the disease complete.

Under the history of the diseases of 1792—3, I have related the progress of the late scarlatina in this country. There cannot be a stronger evidence of the progression of an epidemic influence in the atmosphere than the history of that distemper

per

per has furnished. The violent stage of that disease, was preceded four, five, and in some places, eight months, by a milder species of the disorder; and this mild form was, in some places, an epidemic. These facts entirely overwhelm all the pretended influence of infection in originating the disease. They prove, incontestibly, that a state of air suited to the production of that disease, was not the effect of any sudden, visible change in the seasons; for the mild form of the scarlatina appeared, indifferently, in every season of the year, as at New York in August, at Hartford in May, and at New Haven in November; but that it was a progressive change, gradually inducing debility in the human body, or whatever else may be its predisposition to a particular disease.

Whether the scarlatina appeared in any part of the country, without being announced by this slight form of the disease, is a question which cannot be solved, without particular information from every town. And, very possibly, the fact itself may have passed, in some places, unobserved. But the progressiveness of the distemper was distinctly marked in New York, in Fairfield, in New Haven, in Bethlem, and in Hartford.

The same phenomenon was observed in the same disease in 1786, in London. The first case appeared in March, was of a mild kind, and excited

no great apprehension. No other case occurred, to the knowledge of the physician, except in the same family, till May, when another case appeared; but of a light kind. In June the disease became epidemic and malignant. Here we observe the progress of the pestilential principle in England, like that which has been observed in America.

See Memoirs of the Medical Society, London, vol. i. p. 388.

A remarkable fact, mentioned by the great Mr. Boyle, in the fifth volume of his works, p. 724, serves to shew the regular progression of that state of air which produces the plague. In 1665, three months before the plague broke out in London, a man sent for a physician, complaining of a swelling in his groin, from which circumstance he predicted the plague which was to follow, and said he had experienced the same swelling in the former plagues, which he considered as the certain forerunner of the disease. Boyle took this account from the physician himself.

This is no whim, for it is perfectly philosophical. It is a common fact, that, during the plague in a city, persons in health experience severe pains in the glands, as in the groin and under the arms, those sensible parts which are peculiarly affected by the disease. Sorbait mentions, that he felt

such pains during the plague in Vienna, in 1679, and others did the same, but without any tumor. Dr. Gattwald experienced similar pains in the plague at Dantzick in 1709.

See Baddam's Memoirs, vol. vi. p. 12.

Boyle, vol. vi. 429, relates, that one Beal knew a woman who could certainly tell when the plague was in the neighbouring country, by a pain in the wounds of three sores she had when affected by the plague in her youth. The relation is altogether credible; for we know that the state of air producing the disease, occasions pains in the glands of persons in health; much more, therefore, would the same parts, after being rendered more sensible by plague sores, be affected with pain during a similar state of air. The facts demonstrate, that the plague is produced by a peculiar state of air, which may be perceived before the disease appears; and much more, during its prevalence, by persons in health.

Another fact, demonstrative of the same doctrine of a progression in the pestilential principle, is, the unusual number of abortions which precede the invasion of a severe plague. This fact was observed by Diemerbroeck, previous to the plague in Nimeguen, in 1636; and is numbered by him among the presages of the disease—*De peste*, page 11. Other authors have recorded the same fact,

fact, among whom Diemerbroeck cites Alexander Benedictus, Forestus, and Sennertus.

The cause assigned for this phenomenon is, "the debility of the heart and other viscera, which renders the tender body of the foetus incapable of resisting the malignity of the pestilential poison, and which exposes the woman, in a pregnant state, to continual irritation."

In confirmation of this principle, we may cite the facts so frequently mentioned by writers on this subject, that the plague rarely or never spares pregnant women. This was remarked by Livy and Dionysius in Rome—by Procopius and Evagrius, in the plagues of 543 and 590; and by subsequent writers.

The fact authorizes the supposition that a pestilential state of air induces extreme excitement or irritability, and, consequently, indirect debility, especially in the nervous and vascular systems. The effect of this general cause must, of course, be first visible in persons most susceptible of excitement, among whom are pregnant women, which is obvious from the facility with which they receive impressions from the sight of unnatural objects. The appearance of the effect of the pestilential state of the atmosphere on such persons, *previous to its fatal effects on other persons*, leaves no room to question its gradual increase of strength.

Of the progressiveness of pestilential epidemics, therefore, we can have no doubt, nor of their connection through a common cause. The order in which they shew themselves is not always the same, being varied by a multitude of subordinate causes, as seasons, weather, noxious exhalations, and sometimes, perhaps, by infection.

The accounts of diseases in the two or three last centuries are recorded with so little regard to just arrangement, that it is not easy to collect from them the exact order, in time, in which the epidemics of any particular period have appeared. Sydenham, however, has left an admirable sample of the history of epidemics in London, from 1661 to 1680—a sample that throws immense light on the principles here maintained—a sample which ought to be well studied, and which it is inexcusable in medical writers not to imitate. Let any man observe the regularity with which certain eruptive diseases, as the measles and small-pox, appeared and subsided, according to the seasons, during the constitution of air fitted to produce them, until both yielded to a different constitution, and then say, whether he can question Sydenham's principles, or the existence of a general contagion, operating in the production of a particular class of diseases. Under a philosophical view of such facts, into what trifles will dwindle all the formidable vulgar doctrines about infection!

It

It must, however, be remarked, that the small-pox, in modern times, will not exhibit similar effects as formerly; since the art of inoculation has nearly banished the disease, as an epidemic, from our cities, where alone it used to prevail to any considerable extent.

Let us then attend to the order of the epidemics which have marked the latest periods of pestilence in America; most of which are within the memory of the present generation.

A. D.

- 1733 Influenza
- 1734 Unknown
- 1735 } Angina maligna
- 1736 }
- 1737 Severe influenza
- 1738 } Pestilence in Barbadoes, Charlestown,
- 1739 } and Mexico. Measles in New Eng-
- land.
- 1740 Measles in America
- 1741 Anginas, pestilence in Philadelphia and Virginia
- 1742 Anginas
- 1743 Pestilence in New York
- 1745 Dyfentery
- 1746 Fevers
- 1747 Fevers

- 1748 } Fevers, dysentery, and angina. With the
 1749 } utmost diligence, I cannot learn whether
 1750 } measles or influenza prevailed during
 1751 } this period. The account, therefore,
 1752 } must be left imperfect
 1753 }
 1754 } Anginas
 1755 }
 1756 Dysentery in some places
 1757 Influenza
 1758 Measles
 1759 Measles, dysentery, fevers
 1760 Unknown till autumn, then
 1761 Influenza, and inflammatory fevers very fatal
 1762 Pestilence in Philadelphia
 1763 Pestilence among the Indians on Nantucket
 1764 Unknown
 1765 }
 1766 } Dysentery
 1767 }
 1768 } Unknown
 1769 Measles, angina
 1770 Angina
 1771 Catarrh, angina
 1772 Influenza and measles, angina
 1773 Angina, dysentery
 1774 Angina, dysentery
 1775 }
 1776 } Angina and dysentery very fatal
 1777 }

- 1778 Fevers, but no epidemic
- 1779 Health
- 1780 Health
- 1781 Influenza
- 1782 Ditto in Europe
- 1783 Measles, angina
- 1784 }
 - 1785 } Anginas
 - 1786 }
 - 1787 }
- 1788 Measles began in autumn
- 1789 Measles, influenza
- 1790 Measles, influenza
- 1791 Pestilence began in New York
- 1792 Angina began in New York
- 1793 Angina, plague, and dysentery
- 1794 Angina, plague, dysentery
- 1795 Angina, plague, dysentery, measles
- 1796 Angina, plague, dysentery, measles
- 1797 Plague
- 1798 Plague, dysentery.

Such has been the general course of epidemic diseases in America, as far as I can obtain information. Further enquiries may render the account more accurate, and more nearly perfect.

It will be observed, that the order is not quite uniform; nor is this to be expected, considering the various causes which concur in the production and diversification of diseases. In general, measles

and catarrh precede anginas, dysentery, and pestilential fevers. And it is remarkable, that these diseases belong to the class of inflammatory diathesis: so does the mild small-pox, which, before the practice of inoculation, was almost regularly a precursor of the plague in the cities of Europe.

In general then, epidemic diseases first attack the brain and the throat, before they seize the whole nervous system, and the abdominal viscera. It is observable also, that winter, spring, and autumn, produce mostly diseases of the stenic diathesis, as measles, catarrh, and inflammatory fevers; and summer, diseases of astenic diathesis, as typhus fevers, dysentery of a malignant kind, and plague. Indeed, the plague seems to begin and end in catarrh—that is, it begins in catarrh in winter and spring, takes the form of plague, during the hot season, and re-assumes the catarrhal and inflammatory form in the succeeding winter.—The measles and influenza, however, prevail at any season.

When I arrange epidemics under particular years, I speak of these diseases which extend over a whole country, or occur in many places. If we look into large cities, we shall find some of these diseases almost every year. But my observations relate only to those diseases when they become general, or occur in various parts of a country in the same year.

When

When I place angina, plague, and dysentery, against a particular year, it is not intended that these diseases were all epidemic in the same place. Thus, while in 1793 the plague was in Philadelphia, the scarlatina was prevailing in New York and the western part of Connecticut. For it must not be overlooked, that although measles and influenza appear nearly at the same time in all parts of the United States, yet the pestilential fevers that follow them first shew themselves in the larger cities in the southern latitudes. Thus the measles and influenza were universal in 1789—90, at least this was the case with the influenza; but the bilious plague broke out in New York, Philadelphia, and Charlestown, before it did in Boston and Newburyport. The same is observable in the other hemisphere. The influenza spreads over Asia, Europe, and Africa, in a few weeks; but the following pestilence first appears in Egypt, or the Levant, or in Turkey, then in the northern parts of Europe. To these remarks, there are few exceptions.

It is also observable, that the pestilence in cities takes the form of petechial fever **and plague**; but, in country towns, more generally terminates in dysentery.

It is a popular opinion, that measles and small-pox never originate in the human constitution without contagion. The palpable absurdity of such

such an opinion, has not prevented its propagation and belief, among even well informed men. So far is this opinion from truth, that the first cases of these diseases, in every epidemic period, are always generated in the human body without contagion. When the condition of the elements is fitted to produce these diseases, they appear in all parts of a country without contagion, they spread rapidly, and decline when the general causes cease to operate. During this period, contagion is efficacious in propagating them, and no longer. When the condition of the elements is not fitted to produce them, if sporadic cases appear in particular habits of body, they will not always spread the disease*. Sydenham, long ago, taught this truth, in describing the changes in the epidemics of 1670, 1672. Measles and small-pox came and went with the seasons and condition of the air.

The truth is, that certain conditions of the elements tend to produce *eruptive diseases*, and before the practice of inoculation, the small-pox was almost regularly one of that series of epidemics which I class together, as of one family, and

* This is here meant of the natural contagion of the diseases from the breath and effluvia, which is not always efficacious in spreading them. The variolous matter of small-pox is excepted, for, if good, this will communicate the disease at any time.

the precursors of the plague. It is nearly allied to the measles, and appears usually about the same time. I am convinced, that catarrh, measles, mild small-pox, and whooping-cough, are but varied forms of disease, occasioned by modifications of the same elemental causes. Certain it is, they all predominate about the same time; and, as a general remark, they *precede* the invasion of diseases which bear the character of *typhus*.

I have never conversed with a physician who could not name instances of small-pox originating without any known contagion; and, generally, medical gentlemen admit the disease to be generated in the constitution. This principle is unquestionably just, and ought to be known and received as truth; for the belief that contagion is necessary to the existence of the disease, has produced most mischievous consequences. An instance happened in Sharon a few years ago, in which a woman was seized with the small-pox, but as she had not been exposed to contagion, her disease was mistaken till just before her death; and twenty or thirty persons were supposed to have taken the disease before the true nature of it was understood.

In the winter of 1797—8 occurred in Hartford two sporadic cases of measles, which could not possibly be traced to contagion. At another time a family was infected by means of a stranger;

but in neither of these cases was the disease propagated to others, who were exposed to the breath of the patients. See Dr. Cogwell's letter, Medical Repof. vol. ii. 301.—Innumerable similar instances may be mentioned.

In the same manner, the various species of angina and the plague occur, in sporadic cases, under the operation of powerful local and constitutional causes, which, if not favoured by the condition of the elements, will not spread and become epidemic.

SECTION XIV.

Of the Extent of a pestilential State of Air.

FROM a view of the facts related in the preceding history, it appears that epidemics, agreeable to the definition already given, are of two kinds; first, those which are limited to a particular town, city, or country; secondly, those which pervade whole quarters of the earth, or the whole globe. The first may be called local, the last general, or universal epidemics.

The local epidemics most usual are dysentery, remitting and intermitting fevers, and pestilence. The epidemic most frequently universal is the catarrh or influenza. Angina is often a general epidemic, sometimes local. Pestilential fevers, in certain periods, become general over vast tracts of the earth. The same is observable of the measles.

The epidemic catarrh is the disorder which most decisively proves a rapid and universal change in the essential properties of the atmosphere. This disease sometimes invades the human race so suddenly, that half the inhabitants of a town or city are seized in a night. I do not find the same fact related of any other disease, except the sweating plague in 1529, whose progress through
Europe

Europe was as rapid nearly as that of the catarrh, and utterly precludes the supposition that infection from fomes had any share in its propagation.

Catarrh, however, is not always a universal epidemic. In many instances, it is confined to one hemisphere, as in 1647, 1655, 1789, and 1790, to America, and in 1650, and 1775, to Europe.

In other instances, this disease spreads over the whole world in a short period, but is progressive, appearing in the two hemispheres in two different years. Thus, in 1761, it was epidemic in America; in 1762 in Europe. In 1781 in America; in 1782 in Europe. In two instances I find it in both hemispheres in the same year.

The compilers of the Encyclopedia say, that catarrh from contagion has "seldom appeared in any one country in Europe, without appearing successively in almost every different part of it; and in some instances it has been also transferred to America, and has been spread there, so far as we have had opportunities of being informed."

See Article, Medicine, No. 253.

No source of errors, in the science of medicine, is more fruitful than the doctrine of contagion. It would seem, from the passage recited, that the writer considered catarrh as propagated by fomites from diseased persons, and conveyed across the ocean by the sick, or in goods,

or

or cloathing. The words will admit of no other interpretation; and yet it is hardly credible, that, in this period of science and observation, an obvious and common phenomenon should be so egregiously misunderstood.

The catarrh, whenever it has appeared as a general epidemic, instead of being *transferred* to America, has usually appeared in America before it has in Europe, or at the same time; and so far is contagion from being the necessary cause of its origin and propagation, that the disease invades seamen on the ocean in the same hemisphere, when three hundred leagues from land, at the same time that it invades people on shore. Of this I have certain evidence from the testimony of American captains of vessels, who have been on their passage from the Continent to the West India islands, during the prevalence of this disease. If further evidence is required, we have the fact, that the epidemic catarrh in America rages with as much violence in the islands as on the Continent, and at the same time. And in the preceding history it is stated, on the authority of a medical publication in Scotland, that the universal catarrh of 1733 appeared in the isle of Bourbon, in the Indian ocean, about the time it did in Europe.

From these facts it is evident that the disease is occasioned by an alteration in the atmosphere. In many instances it is limited to one hemisphere; but

but it is observable, that whenever it appears on the American Continent, it appears also in the islands of the West Indies. Its range is through a certain section of the globe, nearly in the same longitude, north and south, on one of the great divisions of the earth, and in the vicinity of the Continent. The epidemic catarrh of America extends certainly from the northern limits of the United States to the island of Barbadoes. Whether it appears at the same time in South America, I cannot find a hint in any author to guide my opinion, except in regard to the last epidemic which pervaded that part of the Continent.

The catarrh of 1733 extended over the globe; but it appeared first in America. Possibly there may have been other instances since the settlement of America; but I have little information on this point, in regard to this country. It is not probable, for instance, that the severe catarrh of 1708-9 was confined to Europe; but it is useless to indulge conjecture.

The remote cause usually assigned for catarrh is a sudden change of weather from heat to cold, or from cold to heat—the proximate cause, an increased afflux of fluids to the mucous membrane of the nose, fauces and bronchiæ, with some degree of inflammation. Some medical writers seem to think the remote cause to be the application of cold only to the human body, checking the perspiration by the skin, and turning
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ing the fluids upon the mucous membrane. See Cullen on this point.

The proximate causes of the disease are the province of medical men; but to the influence of the remote cause above mentioned, physicians will pardon me for stating a few objections.

1. The application of cold to the body cannot be the sole cause of catarrh, because it appears, and usually with most severity in the spring, on the abstractions of cold. It is observable also, that in many instances its principal violence and mortality is after the return of warm weather, the disease augmenting in violence with the increase of heat. Thus the catarrh of 1709 appeared in Italy, says Lancisius, in January, in severe cold weather, but increased in violence as the spring advanced, and the weather moderated.

The same fact took place in the catarrh of 1762 at Edinburgh, where it began in April, and increased in violence till June.

In the same manner the catarrh in this country in 1790, appearing in March or April, on the moderation of cold was far more severe than that of the preceding autumn, when the weather was changing from heat to cold.

2. It is not always true, that the epidemic catarrh appears in spring or autumn, or after great changes of weather. The noted catarrh of 1580 began to appear in Sicily in the month of

June; at Rome in July; at Venice and Constantinople in August, in the midst of summer. It is against all probability, that this disease can be ascribed to the application of cold. On the other hand, its progress was evidently steady, and uninterrupted by either heat or cold. A careful attention to the history of this epidemic at other times, will doubtless furnish other similar facts.

The catarrh of 1638 seized Germany in summer; that of 1557 appeared in Spain in August; that in America in 1655 began about the close of June.

3. The appearance of catarrh in tropical climates, as in the West Indies, at the same time it appears in northern latitudes, is a strong argument against ascribing it to the application of cold. In the West Indies there is no change of any great consequence in the temperature of the weather: nothing like cold is known in these regions. Yet catarrh, if credible accounts are to be admitted as evidence, is as fatal at times within the tropics as in any other climate.

It is true, that in autumn, winds called *Norths*, northerly breezes, are experienced in the islands, and these produce colds and coughs similar to what we all experience in temperate latitudes on the change of weather, in spring and autumn. But these are very different, at least in degree, from a general epidemic influenza, which seizes mankind in all climates with pain in the side
and

and bones, accompanied often with fever. The universality of this disease bursting suddenly upon all climates, and raging with equal violence in all seasons, and in defiance of heat and cold, leave us no room to question its dependence on some other cause than changes of weather, or application of cold.

4. If the application of cold was the sole cause of this epidemic, it would appear at the same time in all places which experience a sudden change from heat to cold at the same time. And further, a necessary consequence would be, it must be epidemic on every such change. Neither of these cases occurs. On the other hand, the disease begins indifferently in any climate, and in any season of the year, and spreads speedily over whole countries, without the least obstruction from heat or cold. And, as far as I can observe from accounts of it before me, it is as mortal when it invades people in hot climates, as in cold or temperate regions and seasons. It is also progressive in point of place; but it moves with a celerity unknown to all other diseases. Sometimes it passes over Europe in six weeks. In America its duration in 1789 and 1790 was nearly the same. Different epidemics, however, differ in the rapidity of their movements: that of 1580 was about six months in traversing Europe.

Different epidemics also differ in point of generality and violence. Sometimes the catarrh is

a light complaint, at other times it is attended with fever, and occasions no inconsiderable mortality. The catarrh in the spring of 1790 was much more severe than that of the autumn preceding. In 1789 it resembled a severe and universal cold; in 1790 it bordered more on the pleurisy and peripneumony. To those remarks there may have been particular exceptions.

5. It appears to me also, that, with deference to the faculty, a strong argument against deriving the disease from sudden changes of weather only, may be drawn from a difference in the symptom of an epidemic influenza, and of sporadic cases of the disease obviously contracted by cold. Let me ask practitioners, whether, in the epidemic catarrh, there do not appear symptoms altogether unknown in sporadic cases? But as this is a point that regards practice, it is not proper for me to discuss it.

The celebrated Boyle very justly observes, that sudden epidemic colds are not to be accounted for by changes of weather, vol. 5, p. 49.

I do not, however, deny the influence of heat and cold in the epidemic catarrh. In some violent epidemics of this sort, heat and cold seem to have little influence, the disease appearing to rage independent of all the sensible qualities of the air. Yet, in ordinary cases, the temperature of the air seems to *modify*, but not to *degenerate*, or destroy the epidemic.

Brown,

Brown, in his *Elements of Medicine*, arranges catarrh among diseases of the stenic diathesis. Whether he meant to extend his observation to sporadic cases from cold only, or to the influenza also, I do not know. But it may not be improper in me to mention, that, in many epidemics of this sort, bleeding has proved injurious or fatal. The most generally successful remedies have been the diaphoretic, although there have been a few exceptions in which bleeding was salutary. Indeed no disease seems to admit of a greater diversity of symptoms.

Next to the catarrh, in the list of general epidemics, we may perhaps arrange the measles, which, though sometimes a local disease, often appears over whole countries, and sometimes in both hemispheres at the same time.

This disease is attended with specific contagion, which aids its communication from place to place; but it derives its origin from a particular state of the atmosphere. Hence it appears in one season, and disappears in another, yielding to some other disease, as Sydenham remarked in 1672, and which we observed in New York in 1795. It is nearly allied to the catarrh, as is evident from the catarrhus symptoms that attend it, and from the sameness in the mode of treatment. Brown classes the measles in the number of stenic diseases.

It will be found, on examining the history of diseases, that the measles usually precedes or follows an epidemic influenza. The two diseases, therefore, manifest a close alliance in the remote causes.

My accounts of epidemics are too imperfect to authorise the assertion, that these diseases *always* appear nearly together; but this has been the fact, with respect to a number of the last epidemics in America. The order, however, is varied. Sometimes also a slight degree of one or both of these diseases is experienced in particular places, when neither of them is epidemic. But when they become violent and general, they are nearly contemporaneous, spreading successively over a large portion of the earth, and sometimes over both hemispheres.

In 1772 the catarrh and measles raged in the same year, from Boston to Charlestown. To these succeeded anginas and dysentery for a series of years. In 1781 and 2, catarrh pervaded the globe. In 1783 began measles in May, and angina in August. In 1789 measles preceded the influenza. In 1757 influenza preceded the measles.

An epidemic which used formerly to make a figure in medical history, as one nearly contemporary with the measles, was the small-pox. The disease was observed by Sydenham to rage alternately with measles in different seasons of the year,

year. Like the measles, it is an eruptive disease of the stenic species, specifically contagious, and evidently depending on the same general cause, though on different, temporary, or local causes. Inoculation has nearly banished this from the list of epidemics.

But a more formidable epidemic, and perhaps the most formidable to which the human race is exposed, is *anginas*; using this word to denote all the different kinds of the affections of the throat. I call it the most formidable, because hitherto no means have been discovered of arresting its progress. Its horrors and fatality are not mitigated by the inoculation, like those of the small-pox; nor are its usual ravages limited to populous towns, like those of the plague. Under all aspects, therefore, I consider it as a far more dreadful disease than either, because the others may be mitigated or avoided.

Affections of the throat, either in the form of scarlatina, anginosa, angina maligna, cynanche trachealis, &c. are among the epidemics which belong to almost every pestilential period. In the order of appearance, they have not one uniform place; but in America anginas have usually succeeded catarrhs the first or second year, and continue to the fourth or fifth. In the three last epidemic periods, this order has been very uniform. I speak of epidemic angina, which

spreads over the whole country; for in particular places we hear of it almost every year.

These diseases, in our large cities, have been succeeded by the bilious plague, and in the country by violent remittents, typhus and dysentery.

Sometimes angina prevails without being followed by the plague; that is, the constitution of air terminates at that point of its pestilential progress. Such seems to have been the fact with the angina of 1755. And in all cases in which it is of a mild kind, or not universal, strong hopes may be entertained that no plague will follow it. The epidemic anginas from 1783 to 1786 were of this kind.

With respect to the universality of the cause of these epidemics, it is to be observed, that it is of two kinds; sometimes it extends to both hemispheres, at other times it seems to be limited to one. Those diseases, however, which are least influenced by heat or cold, or which depend most on some invisible state of the atmosphere, appear most frequently in both hemispheres at the same time. This fact, with respect to the catarrh, has been particularly noticed.

The same fact is observable very often with respect to the measles, and especially with regard to anginas. These affections of the throat, when violent, are nearly contemporary in Europe and America. Witness the periods from 1751 to
1756,

1756, from 1773 to 1776; 1783 to 1786—from 1793 to 1796, and in 1742.

This contemporaneousness of certain epidemic diseases, in both hemispheres, is an important fact which has hitherto been little noticed, but which opens a new field for philosophical investigation. It demonstrates that such diseases are occasioned solely by a constitution of air, without the influence of contagion, although when the diseases are formed they are contagious.

But we have further facts of a similar nature. It is observable, that the pestilential principle often extends from Egypt, Syria, and Turkey, over all Europe, and to America. But the same diseases, that is, the same forms of the pestilence, do not always appear in Egypt, or Turkey, and in France, England, and America, in the same year. It is a general fact, that the worst form of pestilence, the inguinal plague, appears first in Cairo, Smyrna, or Constantinople; and from this circumstance the advocates for the propagation of that disease by specific contagion, have drawn their most powerful arguments in support of their theory. But this argument is founded on a view of the subject most miserably narrow and obscure.

In every pestilential period there is a series of epidemic diseases. The order in which they appear depend on local or temporary circumstances. Thus, in Grand Cairo, or Constantinople, the climate,

climate, or the strong local causes, speedily bring the pestilential principle to its crisis, in the production of the plague. For this reason that disease appears in those cities sometime before it does in northern latitudes, or in more healthy cities.

But at the very time the plague appears in Constantinople or Cairo, some lighter epidemic disease, belonging to the series, appears in other parts of the world, indicating the approach of pestilence. Thus, in 1580 and 81, Cairo was desolated by a hideous plague; but at the same time a severe epidemic catarrh burst forth on all Europe, the certain forerunner of pestilential fevers, and which, in that instance, was succeeded by plague in 1582 and 3, as far North as England.

Let facts within late periods decide this question.

The plague appeared in the Turkish dominions in 1718; but in 1719 became more general. In 1718 the Bills of Mortality were considerably swelled in Amsterdam, London, and Vienna; but in 1719 they rose in the two former cities considerably higher, the pestilential state of air pervading most of Europe. I have no account of the state of diseases at Marseilles in 1718; but in 1719 appeared a pestilential fever, which increased the mortality, although the pestilential principle

principle did not rise to its height till the subsequent year.

In this period, contemporary with the plague in the Levant, was a universal increase of mortality in Europe; and the same state of air was experienced in America, although in very few parts of Europe did the pestilential principle arise to the degree of plague.

In 1726 we again hear of the plague in Egypt; and, for two or three years succeeding, the Bills of Mortality were swelled in Europe and America. Of the epidemics that prevailed in America, I regret my want of information. I only know that measles and malignant pleurisy prevailed in this country.

In 1735 and 6 raged the most desolating fore throat in America; and, at the same time, the most fatal plague in Egypt that has appeared in this century. This pestilence, like that in the time of Thucydides, took its rise in the interior parts of Egypt or Ethiopia. And it must not be overlooked, that the violence of the pestilence in Egypt corresponded with that of the fore throat in America, a fact which, as far as I can discover, is generally true, that the more fatal the epidemics that prevail over one quarter of the globe, the more violent are the same, or other pestilential diseases, in the other hemisphere. It makes little difference, that in one country
rages

rages the glandular plague, and in another the petechial fever, or putrid sore throat. These are only different forms of pestilence, *the effects of one common cause, modified by local causes*. The great point is, that such epidemics are *contemporary in countries the most remote*. Slight epidemics may appear alone; but never the more severe and deadly forms of pestilence, excepting, perhaps, dysentery, or some other complaints that depend mostly on the seasons.

The years 1740, 41, and 42, were also pestilential. At what time the plague of this period first appeared in the East, I am not informed, but it raged in Syria from 1742 to 1744; and it rarely happens that it is not a year or two earlier in Egypt or Constantinople than in Syria. Contemporary with the plague of this period, was great mortality in London and Amsterdam, from the petechial fever, which fell but little short of the plague. See the Bills.

At the same time raged in America a series of epidemics, particularly measles, anginas, and the bilious plague; the latter appearing in Philadelphia and Virginia in 1741, and in New York in 1743, the same year with the dreadful pestilence in Messina.

The year 1755, the year of a great plague in Constantinople, was distinguished for catarrh in Europe,

Europe, and sore throat both in Europe and America.

In 1758 commenced the pestilential period, which was universal, and felt in both hemispheres, in some one, or all, of the years from 1758 to 1763. Here, it is observable, our information is more correct. In 1758, contemporary with the beginning of this pestilence, was an epidemic catarrh in Europe. Then followed other epidemics of a more malignant type. During this pestilential period, appeared in America the catarrh, measles, and the plague in Philadelphia in 1762; but especially the fatal epidemic pleurisy in 1761.

The next period commenced in 1769 or 1770, in which the plague spread over the East. This period was begun by measles and anginas, if my information is correct, in 1769. Catarrh was epidemic in 1771 and 2; and in the latter year measles of a bad type. Then followed angina, and the epidemics all closed in dysenteries. The plague in the Levant was contemporary with the commencement of this period.

I am not informed of the precise time when the plague of the next period commenced in the Levant, but it was raging in 1783 and 4, during the prevalence of measles and angina in America.

In the last period the plague in Egypt was very violent about the time the mortality commenced

menced in America. Of the precise time when it began in Egypt I am not informed; but it prevailed in 1791, the year it appeared in New York and Grenada, and was most destructive the following year, 1792, the year when the scarlatina appeared in the northern parts of America.

I have no farther accounts of the plague in Egypt; but the public prints have informed us the disease prevailed in Constantinople in 1797, and was more general in the Turkish dominions in 1798, the most fatal year in America.

The reader will be pleased to remark, that when I speak of the plague in Grand Cairo or Constantinople, I refer only to violent and destructive epidemics. The plague, in a light form, and in a few cases, occurs almost annually in those great cities where the common causes and ordinary seasons are adequate to its production in particular constitutions. But, let me observe, that no extensive or desolating plague ever ravages either of those cities, except under the influence of a general contagion, or an epidemic state of air, which is experienced nearly at the same time in Europe and America.

These facts enable us to solve the whole difficulty which has puzzled physicians, in regard to the different kinds of yellow fever which appear at different periods in the West Indies. The simple truth is, that, in ordinary seasons, when
no

no pestilential constitutions of air exists, the fever of the West Indies is not contagious.

But after catarrh has pervaded the hemisphere, and during the increase of mortality in the Levant, in Europe, and on the American continent, that is, during a pestilential state of air, the fever of the West Indies assumes double malignity, and becomes contagious. In years of health the disease never attacks natives of the islands; but in unhealthy periods, not only native whites, but even blacks, are sometimes affected with the disease. Among these, however, it is less destructive.

Thus we solve the problem which has embarrassed all the medical writers on the yellow fever, the most able of whom have been compelled to declare, that the fever in the islands is sometimes contagious, and at other times not.

This view of the subject would have prevented the trouble of authors who have laboured to prove the disease imported from Siam, or the African coast. Dr. Chisholm, instead of attempting to trace the Grenada fever of 1793 to Africa, through the ship *Hankey*, had only to remark the prevalence of the catarrh in 1790, of the plague in Egypt in 1791, and of the scarlatina in the United States in 1793, and he would have seen the beginning of a most extensive and malignant series of diseases. The truth is, the pestilential

lential state of air first manifested itself in Grenada in 1791 (the year it commenced in New York) by new and singular symptoms, which surprised Dr. Chisholm. And this, by the way, was before the beginning of the present war on the part of Great Britain; and, of course, it could not be ascribed to that circumstance. The same fact, when justly considered, is demonstration that the disease was not brought from Africa.

It must be remarked, however, that the fever of the tropical climates, though not contagious in sporadic cases in healthful years, may at any time become epidemic and contagious under certain circumstances. Thus large bodies of soldiers and seamen, passing suddenly from high northern latitudes into the West Indies, may contract the disease, and render it so violent by crowded camps and ships, as to render it very infectious. This is usually the case in wars between England and France, which call great numbers of men from Great Britain into the islands.

Yet, even in this case, the mortality of the disease is increased by a pestilential state of air, concurring with such local causes. Such was the state of air from 1760 to 1763, during which the British and American troops perished before the Havannah. Such also has been the state of air for eight years past, in which the destruction
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of the British troops in the islands has been unparalleled.

This circumstance has led a respectable College of Physicians in Philadelphia to insinuate that war is a cause of the disease. Their words are, "It exists in the West Indies, particularly in time of war, when great numbers of strangers are to be found there, and reference to dates will show, that in *most* of the instances of the occurrence of the disease in the United States, there has been war in the West Indies." Memorial to the Legislature of Pennsylvania. Dec. 5, 1797.

This assertion, however, is not authorized by facts. The deplorable plague in Philadelphia and Charlestown in 1699 was in time of peace. That in New York in 1702 was in the first year of a war, but could not have been derived from that circumstance in so short a time. The same disease at Barbadoes and Martinico in 1723, was in time of peace; in Charlestown, in 1728, in time of peace; at Carthagená, the next year, in time of peace; at Charlestown, in 1732, in time of peace; at Barbadoes, in 1738, in time of peace. The instances which happened between 1740 and 48 were in time of war, as was that in Philadelphia in 1762. The present war has exhibited melancholy effects of diseases in the West Indies; but it is an indubitable fact, that the plague of the present period commenced in 1791, a year before

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before the war, and before numerous reinforcements of troops had been sent to the islands. It must further be observed, that during the eight years war between America and Great Britain, no yellow fever appeared in the United States! a striking fact!

It is certainly a most unfortunate circumstance for the credit of the College of Physicians, that the longest interval of peace during the present century, from the treaty of Utrecht in 1713, to the Spanish war of 1740, includes in it the longest and most severe state of pestilential diseases in Europe, Africa, and the islands, that has occurred during the century. A simple inspection of the Bills of Mortality during that period will demonstrate the fact.

One thing however may be asserted with truth, that whatever may be the extent and violence of the bilious plague in the West Indies, it never has appeared in the northern parts of the United States, except in periods when a pestilential or sickly state of the air is manifested by the prevalence of other epidemics. In tropical climates, and in the southern parts of America, particular circumstances, as great bodies of fresh troops from northern latitudes, or unfavourable seasons, may generate the disease in any year, however healthy, in temperate latitudes. But from Maryland northward, this American plague has never appeared without being preceded by other epidemics.

demics *. Let facts be resorted to for confirmation.

We read of malignant diseases in America anterior to the year 1699, but the order of them is not described. The fatal plague of that year was preceded by epidemic catarrh; and the plague raged at the same time in the Levant. The same disease in New York in 1702 belongs to the same period, which seems to have commenced in 1697, and ended in 1702.

The next sickly period was from 1709 to 1713, beginning in Europe with the severe catarrh of 1709, which was followed by plague in the Baltic-towns, in Hungary, Vienna, &c. accompanied by a most desolating sickness among horned cattle and horses in Germany and Italy. Of the effects of this constitution of air in America, I have but two instances, which were a most distressing sickness in Waterbury in Connecticut, which almost depopulated the town, and epidemic measles in 1712.

Of the most pestilential period about 1720, I have also but two instances in America: the mortality at Duck-Creek, as already related, and the malignant pleurisy at Hartford.

* The plague in Philadelphia in 1747 may be an exception, for I have no information what diseases preceded it. But I believe this will be found no exception.

The plague in Philadelphia and Virginia in 1741, and in New York in 1743, was preceded by the usual epidemics, influenza, measles, angina, &c. ; and, at the same time, the plague was raging in the Levant, and in Sicily.

The same disease in Philadelphia in 1762 had its usual precursors, measles and catarrh ; and this occurred during the prevalence of the plague in the Levant.

I hardly need to mention, in proof, the present epidemics. It is well known we have passed through the whole series of precursors, catarrh, scarlatina, measles, &c. the two former being far more general and severe than usual, indicated with infallible certainty the violence and extent of the plague which was to follow.

From a long series of facts, then, we demonstrate that the plague of our climate depends on some *general cause*. And it must abash and confound the sticklers for the propagation of this disease from country to country by fomes, to know that the disease never occurs in the temperate latitudes of America, except under a pestilential constitution of air, manifested by other malignant diseases in this country, which are certainly *not* imported ; and during also the prevalence of similar diseases in the Levant, and an increase of mortality in other countries. It must still more confound these persons, if they have any susceptibility of conviction, to observe that

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these

these very pestilential diseases, instead of being conveyed from place to place, appear at one and the same time in Egypt, Turkey, the West Indies, and in the United States. This is a very common, and probably is always the fact.

If the pestilence were introduced into this country from the islands; and if the disease is capable of being propagated as an epidemic from fomes, why, let me ask, has it never been propagated in the United States in healthy periods? It has been *imported* probably in hundreds of instances from the islands ever since the commencement of the West India trade.

Not a year passed from 1763 to 1791 in which multitudes of seamen or passengers were not brought into the United States, into large and small towns, and into hospitals filled with patients with the yellow fever upon them, and all their infected cloathing. Yet, in all this long period, no contagion appeared, although no precautions, at least in many parts of the country, were ever taken to prevent it. If the disease contains specific contagion, surely that contagion must take effect under all circumstances. Every man knows that the variolous matter of small-pox regards neither time nor place; its contagion acts in all years, seasons and climates.

This fact alone, that the bilious plague never shows itself in the temperate latitudes of America, except when the current epidemics of this country manifest a general constitution of air unfriendly to health, is sufficient to explain all the difficulties that have occurred to medical men and to others on the subject of the origin and peculiar symptoms of the disease.

Some of these remarks are in anticipation of the subject of another section, but they fall naturally enough under this head; the design of which is, to establish the doctrine of the universality of certain diseases at particular times, occasioned by a cause or causes extending often over a whole hemisphere, and sometimes over the earth. That such is the fact is demonstrated by the history of epidemics from the earliest ages to this day. A successive series of similar facts occurring age after age, leave no room for cavil or controversy.

I have confined my remarks on this head to the latest periods of the world, because the evidence is more complete. But a simple inspection of the preceding history will convince any candid person that the phenomena of pestilence have been uniform from the highest antiquity. In the most barbarous ages, when commerce was unknown, all the severe plagues appeared in almost every part of the earth in high northern latitudes, and
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among savage tribes which had no intercourse with the Mediterranean. The custom of deriving all plagues from Egypt, Syria, or Turkey, by specific contagion, is *modern*; it is pointedly contradicted by all history—is unworthy of the enlightened period in which it has been advanced, and marks an extreme degeneration in philosophy.

SECTION XV.

*Of the Phenomena which attend pestilential
Periods, with Conjectures concerning the
Causes.*

IT will not escape the most inattentive reader of the foregoing history, that all the violent and general plagues have been preceded or accompanied with remarkable phenomena in the physical world, as comets, earthquakes, explosions of volcanoes, and others of a subordinate kind.

We are to admit, with great caution, the influence of the planets in producing the calamitous diseases which, at periods, afflict mankind. It is an influence very uncertain and undefinable. It is not, indeed, unphilosophical to suppose the several immense orbs that compose the solar system to have an influence on each other by means of the great laws of attraction and repulsion. The contrary supposition would be most unphilosophical. But it might be very difficult to ascertain precisely what that influence is, because it might not be possible to separate its effects from those which are produced by other causes.

The ancients went much too far in ascribing events on this earth to planetary influence. They ascribed not only natural, but moral effects to
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that influence; and, by their extravagant system of judicial astrology, brought into contempt the study of the influence of heavenly bodies.

We are not, however, to discard all considerations of such an influence. We are naturally led to suppose that all parts of our system are connected by principles of attraction; and that a certain order and equilibrium are necessary to keep all parts in due harmony. It is very obvious, that the moon has a most material influence in regulating the seasons and changes of weather on this globe, especially the weekly and monthly vicissitudes. The more distant bodies may have similar effects, though less obvious.

Comets, which approach and enter the solar system at certain unequal periods, may also have some influence upon the seasons. To ascertain this point, I have collected all the information my reading has enabled me to discover.

The ancients believed those bodies to be the causes, or at least the harbingers of pestilence, according to that line of Claudian,

"In cælo nunquam spectatum impunè cometam."

"A comet in the heavens is never beheld with impunity."

But should the fact be admitted, it might be still a subject of enquiry by what means these erratic bodies injure the health of mankind. That they have some effect of this kind seems to be
very

very probable, not only from the opinion of the ancients, who were careful in their observations, but from the very uniform coincidence of their appearance with extensive pestilence.

It is certain that comets have a very sensible effect on the weather. This was observed as long ago as the days of Aristotle, who remarks, Meteorol. lib. i. ca. 7. that comets denote great heat, tides and winds. He instances the swell of the sea when Achaia was inundated, which was during the appearance of a comet. Pliny makes a similar observation. "*Ventos autem ab iis graves aestusque significari.*" Nat. Hist. lib. ii. ca. 25. Seneca was of the same opinion, and he mentions storms of rain also among the effects of their approach.

Seneca, Nat. Quest. lib. vii. sect. 28.

It is true that great heat and drought, and violent tempests, mark the periods of the approach of comets; and it is equally true, that the winters of the same periods are remarkably cold. Aristotle himself mentions the cold of the winter during the appearance of the great comet, when Aristeus was Archon of Athens.

The preceding relation of facts furnishes a confirmation of these opinions. All the comets which have approached this earth in their passage to or from the sun, especially those which have passed very near us, have been preceded, attended,

tended, and followed, by most extraordinary effects, as great heat and drought in summer, and severe cold in winter; deluging rains, violent tempests, and unusual tides. These we may consider as the constant and certain attendants on comets. They occur so uniformly with the appearance of those bodies, and for some months preceding and following, as to leave no room to question the influence from which they proceed.

Through the medium of such great changes in the seasons, we may rationally suppose comets must affect the health of mankind. Extreme and unusual heat seldom fails to produce a multitude of autumnal diseases, as may be seen by the Bills of Mortality, and as the observation of every person can verify.

It is obvious, from the foregoing history, that one of the most certain effects of the approximation of a comet is a most severe winter. The almost uniform coincidence of these two phenomena leaves us no room to doubt their connection. Now it is a law of the seasons, that the mean temperature of the air is nearly the same every year. This has been proved by seven years observations made at Salem by Dr. Holyoke, and published in the first part of the second volume of the Memoirs of the American Academy. When, therefore, the cold of winter is long or severe in an unusual degree, it must be counter-balanced in the succeeding seasons by an extraordinary degree of

of heat. This may happen to be effected by long mild weather in spring and autumn, but it is more usual that severe winters are followed by excessive heat in the summer months. In this case the human body never fails to suffer. In such summers bilious fevers and dysenteries are commonly numerous and violent.

If therefore comets do in fact produce unusually cold winters, which are necessarily preceded or followed by excessively hot summers, they may be considered as the remote cause of numerous diseases.

But comets do, most evidently, occasion at times excessive drought; and at other times extraordinary quantities of rain; and these intemperate seasons not unfrequently succeed each other within a few months. No man can question this fact who attends to the preceding history. All such unusual seasons are apt to injure the vegetable kingdom. In too dry seasons corn may be defective in quantity; in too wet weather it is deficient in nourishing qualities; and in both cases it may contain the germs of epidemic diseases.

That comets should affect the health of mankind in any other way than through the means of the seasons or weather, is possible; but is not to be admitted without most indisputable evidence. It is indeed certain that the oriental nations believe, and have from high antiquity believed these bodies to be the forerunners of plagues;

plagues; and the enumeration of facts in the foregoing history evidently confirms their opinions. That history is probably defective in accounts of comets; but imperfect as it is, it affords proof that most of the plagues which have been extensive and severe, have been preceded or attended with the approach of comets.

From numerous facts in the history of pestilence, I am led to suspect that comets have some effect on the fire or electricity which surrounds and penetrates this globe. One of the most certain, as well as the most remarkable phenomena which attend plagues, is earthquakes; and, in general, the more severe or numerous have been the earthquakes, the more violent and destructive the plagues. This remark applies to most of the countries in Europe where the plague has been epidemic; but is more especially true of Italy and the Syrian coast, with the whole of Asia Minor.

In confirmation of this remark, we need not resort to facts in ancient times, when earthquakes seem to have been more frequent and violent than in modern times. Within the present century, the shocks which have uniformly attended pestilence, leave no room to question that some connection exists between the two phenomena.

Now, it is a fact that will appear from an inspection of the preceding history, that during
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the approximation of comets to our system, earthquakes have been most numerous, general, and violent. A great proportion of the tremendous eruptions of volcanoes have happened during the same periods. To prove this, we need not go back to the terrible concussions and violent discharge of Etna, which closed the long pestilence in Athens in the fifth and sixth year of the Peloponnesian war; nor to the dreadful earthquakes and eruption which preceded the destructive plague in the reign of Titus. We have similar facts in modern times. The plagues in the Levant in 1743, and especially in Messina, were accompanied or preceded by violent earthquakes and a comet. The extensive plague of 1760 was attended with all the great phenomena, comets, eruption of Vesuvius, and tremendous earthquakes. The pestilential periods of 1770 and 1783 were introduced by the same phenomena.

These facts afford strong evidence that the approach of comets not only influences the weather, but also calls into action the subterranean fires. By what means these erratic bodies produce this effect may be a curious question. That the internal fires explode at times without the attractive powers of comets is undoubted; but the concurrence of earthquakes, and violent discharges from volcanoes during the appearance of comets, or near the same time, seems to

render it certain that those bodies have a most powerful effect on the element of fire, which is diffused through the globe and the surrounding atmosphere.

Many authors have observed the connection between comets, earthquakes, and pestilence, but seem not to have included volcanic eruptions among the causes of disease.

"In cælo per quindecim dies apparens crinitum sidus siccatis plane terris attulerat," says Paulus Jovius: *"pestilentia quoque contagiis serpens, et in urbe et in castris."*

Hist. Vol. ii. 111.

This observation of the writer is well founded. Comets seldom fail to occasion a universal defect of rain and springs in some countries, and pestilence marches in the train with its other effects.

"Inter prognostica pestis est etiam cometes, jaculum et aliæ figuræ ardentes, diutius in suprema æris regione subsistentes."

Horstius, from *Angelus Sola, de peste*, p. 253.

These remarks also are justified by our own observations. They were remarkably verified in the comet, the meteor, and the brilliant halo which marked the commencement of the last series of epidemics in 1788 and 1789.

Riverius is express to the same point. He asserts that comets never appear without being followed by epidemic and pestilential diseases, and

and various changes in the physical world. He instances that of 1618 in his own days. The observation is verified by the testimony of all ancient writers, and by a uniform series of modern facts.

The order of events is exemplified in the epidemic period of 1769 and 1782. In the first period excessive drought during the approach of the comet in 1769; failure of crops, famine and plague, and insects in 1770; volcanoes, earthquakes, and tempests in 1770 and 1771; catarrh and measles in 1772; then for several years anginas, putrid fevers, and dysenteries.

In the period of 1781 and 82, catarrh began the epidemics; in 1782 a universal failure of water, and of crops in India and Egypt; in 1783 a volcanic eruption, famine, measles, angina and plague; in 1784 a comet, followed by tempests, &c.

Earthquakes constitute part of the visible effects of the general cause which produces pestilence.

It has sometimes happened, that in these convulsions of the earth a vapour has been extricated which has produced immediate disease. The great earthquake in South America in 1730 was speedily followed by a pestilential fever. The destruction of Port Royal in Jamaica in 1692 was soon succeeded by a mortal fever in all parts of the island; and the universality of the fever would

would lead us to suspect that vapour, in this instance, could not have been the cause. At Venice, in 1343, the plague soon followed an earthquake.

In the year 615 violent earthquakes in Italy were followed by "*lues elephantia*." Baronius, vol. viii. 243. Baglivus relates that the great earthquakes in Italy in 1703 were succeeded by numerous diseases, especially ophthalmia, erysipelas, mesenteric fevers, and double tertians. In autumn the small pox became epidemic, apoplexies were frequent, and sudden deaths almost daily. With respect to apoplexies and sudden deaths after earthquakes, we have also the authority of Seneca.

Baglivus further remarks, "*post terræ motus frequentu succedunt pestilentia, vel morbi graves et epidemici, imo nova et inaudita morborum genera*." p. 530. The idea that new and unknown species of diseases follow earthquakes, if well founded, leads us to suspect that the changes in the characters of diseases are attributable to the various action of the electrical fluid.

The terribly destructive earthquakes in Naples and Sicily in 1693, were speedily followed by malignant fevers, tertians, accompanied with delirium and lethargy; and the small-pox, which was very fatal to children.

Baddam's Mem. vol. iii. p. 91.

"Frequent earthquakes," says Fracastorius, *de contagione*, p. 136, "announce future pestilence ;

and by means of exhalations tend to produce it." Van Swieten agrees in this opinion.

Seneca asserts, Nat. Quest. Art. 27, that pestilential diseases usually follow great earthquakes. He supposes the air inclosed in the earth to become vitiated, either by stagnation, or through the defect of the internal fires: "*internorum ignium vitio.*" He thinks this air, when forced into the atmosphere, renders it impure, generating new kinds of diseases. He reasons by analogy, that as water corrupts by stagnation, so will air. Hence, after earthquakes, "*subita continueque mortes et monstrosa genera morborum, ut ex novis orta causis; nec prius pestilentia desinit, quam spiritum illum gravem exercuit laxitas celi, ventorum jactatio.*"

This opinion of Seneca is certainly entitled to respect, and has been followed by many distinguished authors, Van Helmont, Van Swieten, Sydenham, Hodges, Baglivus and others.

But I suspect the modern discoveries will enable us to furnish a more rational solution of the phenomenon. I am inclined to believe that a superabundant stimulus occasioned by the shock of an earthquake, and an atmosphere surcharged with electricity, will more rationally account for the sudden deaths, apoplexies, small-pox and malignant fevers. If a deleterious vapour were the cause, I should suppose its effects would be speedy, and its

its force soon expended, the atmosphere being speedily purified by winds. But if stimulus is the cause, it may exist for a long time in the atmosphere, and the human body not yield to its force for many weeks or months. This would better accord with facts, for although diseases appear soon after an earthquake, yet the worst effects are often many months or a year after, as was the case in the reign of Titus, when the pestilence was the year after the earthquake and eruption of Vesuvius.

There are, however, many authorities in favour of the vapour. Seneca relates, that a vapour, caused by an earthquake in Campania, destroyed six hundred sheep. Van Helmont says, that "popular plagues do draw their first occasional matter from an earthquake."

P. 1125.

The fact that a visible vapour, without an earthquake, sometimes appears suddenly in a place, and evidently produces disease, is a strong confirmation of Seneca's opinion. A memorable example happened at Rouen in 1753, as related under that year. Forestus relates, that an epidemic catarrh or sore throat in Alkmaer, A. D. 1557, suddenly invaded 2000 persons, of whom 200 died. He ascribed it to a vapour, for the disease was preceded by thick clouds of an ill smell.

See Van Swieten, vol. xvi. p. 31.

Mezeray relates, that the black pestilence of 1347 arose in China from a vapour, which burst from the earth with a smell most horribly offensive. This fact is cited by Boyle, vol. v. p. 60. in proof that pestilential diseases spring from vapours evolved from the earth. This author supposes new diseases may be generated by vapours; and remarks further, that countries abounding with cinnabar escape the plague.

But it seldom happens that pestilential diseases can be traced directly to earthquakes. On the other hand, although great plagues are almost invariably accompanied with shocks of the earth, yet it more usually happens that the pestilence appears before the concussion. Thus the shocks which alarmed and laid waste Italy in 1348, 1349, and 1350, were preceded by the dreadful plague of 1347.

Sometimes the earthquakes precede the plague, but more generally the pestilence appears first, or at least the petechial or other malignant fever, which marks the commencement of the pestilence. Thus the plague of 1760 was preceded by a spotted fever in 1759, which marked the approach of the calamity; which spotted fever appeared in Syria *before* the terrible earthquakes of that period.

In the well known plague at Oczakow in 1738 and 39, an earthquake happened about the time the disease began to abate. Van Swieten, vol.

xvi. 47. — Such was the fact in the days of Thucydides. Numerous observations on these phenomena lead me to suspect, that the fire which is to produce the explosion is in violent action for a considerable time *before* the shock, and that it is this *previous action* which occasions epidemic diseases. That is, the stimulus of fire or electricity produces sensible effects on the bodies of animals, the more susceptible objects, before it does on the less susceptible substances in the bowels of the earth.

The earthquakes do not always occur in the seat of the pestilence. I find no concussion mentioned to have happened at London in 1665, or in the years next preceding or following; but shocks were experienced in the neighbouring counties in 1665 and 1666.

This seems to have misled the able Diemerbroeck, who, in reasoning on the causes of the plague, objects to the influence of earthquakes, because no shocks occurred at Nimeguen before the pestilence of 1636. It is probably true, that earthquakes are not usually the *cause* of the plague; but that they have some connection with the cause, I can hardly doubt. The mistakes of Diemerbroeck and others on this point seem to have arisen from considering the plague as an isolated disease, and as depending on a cause local and temporary; whereas, a just view of the subject

ject must comprehend all the diseases of increased malignity which precede the plague, very often for two or three years. Such a view also must include, among the causes of the disease, the agitations or derangement of the elements in remote parts of the country. Thus, although no earthquake was experienced at Nimeguen about the time of the plague, yet a severe shock was felt at Lausanne in 1634. Keyser Travels, 190. This marked some general action of internal fire, which, though it might not explode so as to shake all Germany, might have produced effects, by means of an insensible vapour, or stimulus, in all parts of Europe. Certain it is, that for the period between 1631, the year of the tremendous eruption of Vesuvius, and the year 1637, all Europe was afflicted with mortal epidemics. The philosopher who would obtain just views of the causes, must extend his enquiries to all the great phenomena which occurred during this whole period, in all Europe at least, if not in the American hemisphere: for such a view only will comprehend the whole extent of the pestilential state of the atmosphere.

It must not be forgotten, that during this period, from 1633 to 1637, when the plague, or other desolating diseases, spread over both hemispheres, Etna was in a continual state of eruption; as it was for fifteen years, during the pestilential

tilential constitutions described by Sydenham in his days.

In looking over the list of comets, and the history of earthquakes, I am compelled to believe the approach of comets to have no small influence on the subterranean fires. Such a vastly great proportion of the violent concussions of the earth have happened within a few months of the appearance of comets, that no reasonable man can suppose the coincidences to be the result of accident.

Equally remarkable have been the coincidences in time between the appearance of comets and the explosions of volcanoes. And this fact is no trifling confirmation of my opinion, respecting the influence of comets in producing earthquakes; for earthquakes and eruptions of volcanoes are often contemporaneous*.

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* It is not only during the *appearance* of comets that their effects are perceived in the elements, but for many months *before* and *after*. I can testify, from careful observations, that the effects of that in August 1797 were very obvious, in anomalous tides, as early as the last week in May; and the inundations in England during the autumn and winter following, show its effects several months after its departure. The whole history of comets and their effects warrants this conclusion. Seneca made this remark seventeen centuries ago. These are his words: "*Aristoteles ait, cometas significare tempestatum et ventorum intemperantiam atque imbrium*"—"*Non statim cometas ortus ventos et pluvias minatur sed totum annum suspectum facit.*" Aristotle observes, that comets

I cannot however admit, that the explosions of subterranean fires are the direct existing cause of pestilential diseases. It is indeed ascertained, be-

indicate storms and violent winds and rain. These effects, however, do not immediately follow their appearance, but are to be expected during the whole year. He then mentions, that such was the fact with the comet predicted by Aristotle and Theophrastus, and which appeared in the Consulship of Paterculus and Vopiscus.—Nat. Quest. lib. vii.

I would further observe, that comets move in trajectories of an elliptical or parabolic form, the sun being placed in one of the foci. The time when we observe them is when they pass this part of the ellipsis. Now, according to the universal law of planets, by which they describe equal areas in equal times, their motion must be most rapid when nearest the sun and within our sight. Before their appearance, and after their departure, their movement is slower than when within the solar system, and they may be near the earth many months before they enter the system, or become visible. Hence their influence on the earth so long before and after their appearance.

It is further to be observed, that many comets doubtless enter the system and pass round the sun without ever being seen; and such as come from regions of space, directly opposite to the earth, must be *invisible*, unless we can see them in the splendour of the sun's rays. This remark is as old as Seneca, and older. He relates an instance, in which Posidonius discovered a comet in the darkness of a solar eclipse, which would not have been seen had not the eclipse happened.—Lib. vii. sec. 20.

Newton and Halley have made the same remark. Hence, perhaps, we may account for violent seasons, like the severe winter of 1780, which happened without the appearance of any comet. This is mere conjecture.

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yond all question, that periods of extensive pestilence and mortality are remarkable for earthquakes and eruptions of volcanoes. But the explosions of fire do not so generally *precede* epidemic diseases, as to authorize the supposition that they *produce* those diseases. Earthquakes occur during the prevalence of pestilential or other mortal epidemics, but in the midst of the period, or sometimes at the conclusion.

Hence I deduce an opinion, that pestilence and earthquakes depend on one common cause; which excites into action the internal fires. But I suppose the action or fermentation may precede, for months, and even years, the explosion in earthquakes and volcanoes; and by means of an insensible vapour or heat, or electrical discharges, the elements of water and air may be essentially affected in such a manner as to impair the principles of animal and vegetable life. Whether this is a just explication of the cause, may be a question; but so many phenomena concur to authorize it, that I cannot withhold my assent to the general principle.

The same effect perhaps may be produced by the excessive action of mere stimulus upon the animal system, without the infusion of deleterious vapour into the air.

A remarkable evidence of the effects of fire or electricity on the earth and air, before its explosion, is the extreme drought which is often experienced

rienced over whole continents, or the whole world, for six and even twelve months antecedent to a great eruption of volcanoes.

In confirmation of my principle, that the changes in the elements producing epidemic diseases are effected by the all pervading action of fire, either culinary or electrical, the usual appearance of meteors or celestial lights in pestilential periods must be mentioned. For the truth of the fact we have ample proofs in every age. The instances of meteors, or other celestial appearances of fire, which are recorded of pestilential periods, are so numerous as to leave no room to question the connection between the cause of pestilence, and the fire that belongs to the system. Sometimes these fiery appearances are stationary lights in the sky, which the frightened imaginations of men have formed into armies ready for combat, and considered as the preludes of bloody battles. Sometimes the heavens have been filled with those small meteors, called falling or shooting stars. At other times, immense globes of fire have traversed the celestial regions and burst with a tremendous report.

During a plague in Vienna in 1679, says Van Swieten, vol. xvi, p. 19, from Sorbait, several blueish fiery balls were seen in the air, some of which fell and sensibly increased the heat.

In October 1709, when the plague was in Dantzick, a blue fiery globe came from the north-west

west and shot over the town with amazing celerity, illuminating the town and falling at the southward.

Baddam's Mem. vol. vi. p. 14.

During the plague in Philadelphia in 1793, about the 12th of September, a meteor fell between the city and the hospital.

Rush. p. 108.

During the extreme heat which introduced the pestilence of the last summer, 1798, about the 9th of August, the small meteors or falling stars were incredibly numerous for several nights. They almost all shot from the north-east to the south-west, and succeeded each other so rapidly, as to keep the eye of a curious spectator almost constantly engaged.

Diemerbroeck remarks, that during the summers of 1635 and 36, at the time of the severe plague in Holland, there was a vast number of ardent stars gliding through the celestial regions and falling to the earth; "*Stellarum ardentium in cælo aberrantium magnus concursus et in terram prolapsio.*" He mentions, likewise, almost continual flashes of light, in a serene sky, or silent lightning,

Livy mentions that the heavens appeared to be in a flame, previous to the severe pestilence of the year 290 from the building of Rome.

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A flame in the heavens is noted under the years 733, 742, and 788, all which were pestilential. This flame is not described, and whether it was of the species of Aurora Borealis, which extended over the celestial region, or of that species of light or yellowish red colour, which distinguishes our modern *dark days*, cannot perhaps be determined. But a curious phenomenon of this kind happened in the severe winter of 1741, which was too remarkable to be passed over in silence; especially as it may possibly explain what Livy and many other historians have recorded, that at certain times "it rained blood." The assertion is often found in historians of credit, and has, by the moderns, been numbered among the extravagancies of popular credulity. But an appearance which would warrant such an assertion occurred in this country, and is still recollected by old people.

In the month of January 1741, in the midst of one of the coldest winters of this century, there was a little relaxation of the rigorous cold, during which the heavens were overcast with clouds, and a little rain fell. Late at night, during this falling weather, the heavens appeared all in a flame, so bright as to illuminate the earth, and render objects every where distinctly visible. Many people saw it and were alarmed, supposing the great day was at hand. The rain which fell during this light had precisely the appearance of drops of blood distilling from the clouds.

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This relation was taken from my father, who was then nineteen years old, and recollects all the circumstances more minutely than the events of the last year.

The well known dark day in May 1780 was distinguished by a similar light in the heavens; but not occurring in the night, it was less an object of wonder.

I strongly suspect a similar phenomenon will account for those passages in many histories, which speak of raining blood, and enable us to do justice to the veracity of the writers.

Appearances of this kind have usually occurred in periods of pestilence, when the imaginations of men have been subject to alarm; and they have often happened during extraordinary seasons. The light of 1741 was during a most severe winter, and in the most sickly period that has occurred during this century. See the London Bills of Mortality. In America, that winter was followed by pestilential diseases.

The dark day of 1780 was on the opening of spring, after a most severe winter; and although that year was not sickly in general, yet, in the year following, we had an epidemic catarrh, succeeded by a series of epidemic diseases of other kinds. It is remarkable too, that on that very day began a violent eruption of Mount Etna.

In 1716, in the month of October, happened a dark day: this was after a most severe winter

in Europe. I have no account of the seasons in America; but the next winter was unusually severe, and snow fell in extraordinary quantities.

On the 9th of August, 1732, happened another dark day. This was followed by earthquakes, a severe winter, and universal catarrh.

The 19th of October, 1762, was equally remarkable for darkness, with the phenomenon of a red or yellowish tinge in the heavens, which gave to the sun, when it appeared, the colour of blood. Some rain fell during the day, and the water was of a dirty sulphureous smell. There had been two earthquakes, with epidemic catarrh in America, in 1761. In the same year with the darkness, 1762, the catarrh was epidemic in Europe; and the winter of that year was excessively severe in both hemispheres. A comet appeared in 1762, and an eruption of Etna followed the severe winter in 1763. There were earthquakes also in Asia in 1762. Who can doubt that the vapour occasioning such darkness is the effect of the agitation of the internal fire of the globe?

Similar instances of extraordinary darkness have occurred in every age. They are mentioned in the years before Christ 366 and 295, and of the Christian æra 252, 746, 775, and in many other periods. And the reader will observe, this darkness is contemporary with pestilence in almost every instance. During the plague of 746 the darkness was of several days duration: in 252 it was of three days, and

and in 775 of six days continuance. A similar darkness accompanied the pestilence in Egypt in the days of Pharaoh. Many other instances have been mentioned in the preceding history.

In America it has been customary to ascribe this unusual appearance to condensed volumes of smoke, after burning immense tracts of woods in the western parts of the country. But I cannot learn that any great fires have usually preceded these dark days; and negative evidence, in so many instances, amounts to proof that no great forests have been burnt. Besides, the same phenomenon has been often observed in countries where there were no forests, as in Italy, Syria, Asia Minor, and Egypt, and especially in England.

That the smoke of burning forests cannot be the cause may be rendered very certain by these considerations: First, the cause is not equal to the effect. Had the woods from the 40th degree of latitude in America to the 50th been all consumed in a day, the smoke would not have been sufficient to cloud the sun over the territory covered by darkness on the 19th of May. Any person may judge of this who has seen large tracts of forests on fire. That thirty or forty miles of burning forest should cover five hundred miles with impenetrable darkness, is too absurd to deserve a serious refutation.

In the second place, the colour of smoke, when elevated into high regions of the atmosphere, is very

very different from that of the vapour which causes the darkness on all such occasions. It forms a cloud, of a light woolly colour. Such was the cloud formed by the burning a square in New York, in 1797. The two objects bear no resemblance to each other; common smoke in the air being of a lighter colour, and not tinged with the yellowness of the vapour of dark days.

But what decides this question is the lightning, thunder and rain, and especially the meteors that accompany these clouds of vapour. As far as I can learn, some or all these phenomena attend dark days. Thunder was heard on the morning of the 19th of May, in most places.

Mem. Am. Acad. vol. i. 238.

Violent thunder, squalls and a meteor followed the great darkness in Canada, in 1785. These phenomena demonstrate that the clouds, on such occasions, have a connection with electricity. This is further evidenced by the smell of sulphur in the water that falls, and the scum that is left on objects. Smoke would not produce either; nor would the largest volume of smoke ever raised into the air, spread over an extensive region a dense substance that should become visible and tangible on the earth. Besides, this fog or darkness sometimes happens in winter, when the earth is covered with snow.

When

When we connect with these facts the circumstance that these dark days always occur during or near the time of volcanic eruptions, earthquakes, or the unusual seasons which accompany pestilence, and epidemic diseases of other kinds, we shall be at no loss to charge them to the account of the central fires, or the discharges of electricity. This accumulation of vapour is not a more surprising phenomenon than the sudden change in the properties of the atmosphere which produces universal catarrh. Hodges, who wrote on the plague of London, and who appears not to have been rewarded with celebrity equal to his merits, supposes the cause of pestilential diseases to be a subtle aura, or vapour exhaled from the bowels of the earth, which has, by too much heat and humidity, lost its wholesome qualities. He says, in proof of his opinion, that a given quantity of earth, infused into water in spring, deposits more salt than at another time of the year.

His idea seems to be not very different from that of Van Helmont, who supposes the cause of pestilence to be a gas, or air, which has *putrified by continuance*, as the translation is; by which is meant, probably, a stagnation in the earth.

The doctrine of an insensible vapour, infused into the atmosphere from the bowels of the earth, may perhaps be thought wholly conjectural. But there are some phenomena which can hardly be resolved without resorting to the action

of electrical fluid. The sudden changes of weather cannot be accounted for, in all cases, by changes in the winds. Indeed the most reflecting philosophical men acknowledge themselves puzzled to assign reasons for many of the rapid transitions from heat to cold and from cold to heat. It has been suggested, that the heat may ascend and descend in the atmosphere, by means of physical laws, to us unknown ; but this supposition is not supported by any clear proofs, perhaps not by rational probabilities.

There are many reasons which incline me to believe that the principle of fire, the most subtle, penetrating, active fluid in creation, and unquestionably the most powerful agent in all the movements of matter, passes more frequently and rapidly from the earth into the atmosphere, and *vice versa*, than is commonly imagined. I suspect that an intimate connection subsists, in this respect, between the interior of the globe and the atmosphere which surrounds it.

To the rapid passing of heat from the earth to the air, and from the air to the earth, we may perhaps ascribe many of the amazing changes which take place in the temperature of the air, in a few hours, and often without a change of wind. The increase and moderation of cold are sometimes very obvious, long before the change of winds to which we usually ascribe such changes ; and I suspect that the changes of winds are more
fre-

frequently the *effect*, than a cause of a change in the temperature.

But there are some appearances in the atmosphere, previous to the shocks of earthquakes, which demonstrate a close connection between the atmosphere and subterranean fire. A remarkable one in this country, and generally in others, is a universal serenity and tranquillity in the atmosphere. The sky is cloudless; and all nature, if at night, is wrapped in profound silence. This phenomenon is too uniform a precursor of earthquakes to be deemed an accidental circumstance. It must be an effect of some connection between the air above and the cause of earthquakes.

It is remarkable also that seamen sometimes observe a swelling of the ocean, without wind, and before any shock of the earth; and this fact Pliny mentions among the signs of an approaching earthquake*. The same author mentions a well-known

* Is not this swelling of the ocean, previous to an earthquake, analogous to the tides? May not both be ascribed to the force of electricity? the swell of the water preceding earthquakes being irregular, as depending on no regular visible cause; and the tides being more regular, as being the effects of the moon's influence on the electrical principle. This idea seems to derive some strength from the known fact, that earthquakes usually happen in periods of the moon's revolution, when that orb exerts its greatest influence on the earth. From numerous calculations it appears that earthquakes usually occur near the moon's perigee or apogee, or the change or conjunction of sun and moon; generally

known fact that, some time before the concussion, birds appear to be greatly agitated, and retire. In Italy, a common prelude of an earthquake is, a thin, white, oblong cloud or vapour, nearly resembling the colour of wool. This sign was seen, for several days, in the year 1702, before the earthquake. The same was observed by Cassini, in 1668, in the same part of the heavens, the sign of the whale.

See Pliny, lib. 2. 81. Baglivus, page 543.

The evening before a violent earthquake in Sicily, in 1693, bright flame was observed, ap-

about three days before or after the conjunction.—This, by the way, is the very time when epidemic diseases usually invade the patient, or come to fatal termination, according to the remarks of all modern physicians—a singular fact that may lead to important conclusions.

In a few instances, earthquakes happen near the full moon—the other position in which that satellite exerts more than her ordinary influence on the earth.

Let these facts be compared with the occurrence of violent tempests about the same time of the moon's revolution, the invasion of epidemic diseases, and the full tides.

A strong confirmation of this opinion is derived from the swelling of the sea, just before a hurricane in the West Indies. There is a visible intumescence before the atmosphere is clouded, or the least breeze of wind. What can be the cause, but the electrical fluid which is passing from the earth to the atmosphere, and is speedily to produce most tremendous effects.

See the Addenda.

parently

parently about a mile distant from the spectator: this flame vanished as soon as the shocks occurred *. The day succeeding the first shock, the sky was darkened, and tinged with a deep yellow. This was the presage of a most tremendous concussion, which demolished many towns in Naples, Sicily and Malta.

Seneca relates that a violent earthquake in Campania, although in winter, was preceded by a calm of several days duration.

Nat. Quest. lib. vi. 12.

For some time before the great earthquake in Italy, in 1638, the air was perfectly calm, and the heavens serene; but the sea was covered with little bubbles, as if agitated by drops of rain.

The phenomena that occurred in Germany and Holland, on the day, but *not at the hour* of the tremendous earthquake which demolished Lisbon in 1755, were very remarkable. The water was violently agitated, buoys were broken from their chains, large vessels snapped their cables, smaller ones were thrown on shore, boats in canals were forced from their fastenings, chandeliers vibrated in the churches, water in small vessels was agitated and dashed over the sides; and all this without any sensible motion of the earth or buildings.

See Encyclopedia. Art. Earthquake.

* A similar light was seen at Derby, in Connecticut, in the evening preceding a local explosion of fire, about thirty years ago.

These phenomena indicate a connection between the atmosphere and the subterranean fire, which is altogether invisible, and, to men, imperceptible. We perceive nothing before the shock but universal serenity and calm; but the delicate senses of the fowls of heaven are affected: they fly about in a fright, and appear to want the usual support from the air. The waters of the ocean also swell, although no concussion of the earth or water can be perceived. Do not these phenomena indicate either a want of the usual weight or elasticity of the air? Or what defect is there in the mass of air surrounding the earth, which is to be supplied by an explosion of subterranean fire? That there is a connection or dependence of the fire above on that beneath the earth, and that this subtle fluid acts and re-acts between the earth and the air, with a rapidity and a force beyond all calculation, is to me extremely probable. The appearances that precede earthquakes indicate that the fire which is to produce the shock, is in violent action for a considerable time before the shock. For several days before the earthquake at Oxford, September 17, 1683, *ignes fatui*, luminous appearances, were frequently seen.

Baddam's Memoirs, vol. ii. 208.

It sometimes happens that hot springs burst forth before earthquakes; and miners perceive heat in the earth.

Often

Often have earthquakes been preceded by a perturbation, a stench, or discolouration of the water in wells and springs.

Sometimes the water in wells and rivers recedes or is evaporated before the explosion. It is said that Pherecides once predicted an earthquake in Lacedemon, from the disappearance of the water in a well.

Pliny. Nat. Hist. lib. ii. 79.

The rivers and small streams in Iceland are observed to become entirely dry for some weeks before an eruption of Heckla, as was the case in 1783. Meteors also, earthquakes, and sometimes flashes of lightning, precede or accompany the eruptions.

See Van Troil's letters on Iceland.

The various sounds or noises which precede and attend earthquakes, are a strong confirmation of those ideas. The usual premonitory sound is compared to the rattling of carriages on a pavement. Sometimes it is described as the rumbling of distant thunder. But, in truth, the sound is different at different distances, and resembles no other sound in nature. It is altogether *sui generis*. It is most analogous, when near, to the rattling sound from a near explosion of the electrical fluid: as those can testify who have been near the place where lightning has fallen upon objects. It bears no resemblance at all to any artificial sounds

made by the explosion of gunpowder, or other human contrivances. It is most unquestionably the effect of the electrical fluid rushing from one part of our system into another—probably from the earth to the atmosphere, to restore the equilibrium, which has been, by some means, destroyed, or to answer other unknown purposes. This idea corresponds with the modern theory of earthquakes, which ascribes them to the electrical fluid.

See the Encyclopedia, Art. Earthquake *.

Eruptions of volcanoes have also been preceded many weeks by a visible fog or vapour, suspended over the mountain, as happened before the great discharges of Heckla, in 1783. To what cause shall we ascribe this, but to the action of fire which precedes the explosion? And if a visible vapour may be extricated by this action, *for months* before the explosion, of which we have *certain* evidence, why may we not suppose a smaller action or force to expel invisible vapour, in any place, and at any time?

Other facts authorise this conjecture. On the 12th of September, 1784, the water of the loch Tay, in Scotland, suddenly receded 300 feet, and left the channel dry; then returned; continuing this vibration for every seven minutes, for two hours, and at the same time of the day, for a

* At sea, no noise is heard before an earthquake; water being a good conductor of electricity.

week, with less violence. No wind was stirring, and no visible cause could be assigned for this novel phenomenon. To what cause shall we resort for a solution, but to the invisible energy of electrical fire.

Sinclair. vol. vi. 623.

If we admit, then, the action of electricity to be the cause of earthquakes, we shall have reached the general proximate cause of those epidemic diseases which speedily succeed concussions of the earth. The cause must be the action of fire, the most energetic principle in nature. The manner in which this effect is produced, whether by forcing an unwholesome vapour from the interior of the earth, and vitiating the atmosphere; or whether by simply changing, on mechanical principles, the proportion of oxygen contained in atmospheric air, or by mere stimulus, or other unknown means, is a question of a curious nature, and worthy of a philosophic investigation.

One thing is very evident, that what I denominate a *pestilential principle*, does, at certain times, pervade not only the element of air, but the water also. The proofs of this are abundantly numerous and convincing. In all the great plagues which have afflicted the human race, other animals, as horses, cattle, sheep, sometimes cats, dogs, and fowls, together with the fish in rivers and the ocean, and even vegetables, have borne their share in the calamity. The pestilential principle has extended to every species of life.

The

The beasts of the field perish with deadly epidemics; the fish die on the bottom of rivers and the sea, or become lean and sickly; while corn is blasted on the most fertile plains, and the fruits in gardens and orchards wither, or fail to arrive at their usual state of perfection.

In the destructive plague which desolated Italy in the time of Romulus, Plutarch and Zonaras mention a general sterility of the earth; the very trees were affected, and all nature appeared to be defective in its powers of production.

In the beginning of the pestilential period, in the reign of Justinian, Baronius states that corn was deficient in quantity and defective in its nourishing qualities.

About the year 1600 crops failed in all parts of Europe; as they did in both hemispheres, about the close of the last century. Such was the case in 1740 in some parts of Europe; and in 1766. The failure of grain in India, in 1770, and in 1783 and 1789, are still remembered; and in some of these instances, the crops failed, at the same time, in China, India, Europe, and America.

When excessive rains or dry seasons precede this failure of crops, men are at no loss to assign the cause; although, in these cases, they may sometimes mistake the true cause. But it often happens that grain fails of its usual perfection, in seasons apparently the most temperate and favourable. Observing farmers remark, that, in
certain

certain years, when blast or mildew is expected from intemperate weather, grain proves to be good ; at other times, grain will shrink very much, under a series of weather apparently the most propitious. This has been observed in Fairfield County, in Connecticut, where the excellent lands formerly produced great crops of wheat, with as much certainty as any other grain ; but, within a few years past, wheat has failed, without any apparent cause. In some cases the farmer scarcely receives his seed, although the seasons are favourable, and no insect appears.

The failure of certain species of fruit trees and shrubs is a fact equally remarkable.

Some kinds of apple, and particularly the pippin, for a few years past, have been small, knotty, and sprinkled over with specks.

The plum-tree has become full of warts, or bulbous excrescences, which kill the tree, and, in some parts of our country, bid fair to extinguish the species. These are found to be occasioned by a fly or insect, which perforates the bark ; but it may be considered as a disease occurring at certain periods ; and, in the present instance, has been contemporary with the pestilence in America. The insect itself is an effect of the general deleterious cause.

The peach tree has, within a few years, been particularly subject to be destroyed by a worm, which attacks it just below the surface of the earth,

earth, and separates the bark from the wood. If this is a common evil, still the vast increase of it, at particular periods, is among the phenomena of pestilence. The locust is perishing by a similar malady.

Contemporary with these diseases of the plum and the peach, has been a distemper of the pear, usually called the pound pear, one of the most delicious of the species. For eight or ten years past, that fruit has been universally, in the part of the country to which my observations have extended, subject to a blast, from a species of rust which covers a large portion of its surface. In my own garden, not one in five is fit to eat; but I have seen one gentleman in a neighbouring town who thinks the pear is beginning to recover.

The universal death of the prim is a phenomenon still more extraordinary, and a most severe calamity. The town of East-Hampton, on Long Island, lost, in two or three years, two hundred miles of hedge—a greater loss, says M. L'Hommiedieu, in a paper published among the transactions of the New York Agricultural Society, than if every house in the town had been burnt to the ground: as no proper substitute for fences has yet been discovered. The English black thorn has been tried, but has failed, owing to a fly that perforates the bark.

See Part ii. 103.

The

The cause of the death of the prim is not known, nor the precise time when it began. But in Connecticut the failure was observed, about twenty-five years ago, between the years 1770 and 1777, during the prevalence of the terrible angina and dysentery among men. It continued gradually to extend for some years, and the prim has at last totally disappeared.

It is remarkable that these diseases among corn, fruit-trees, and shrubs, have generally, if not always, appeared first on the Atlantic shore, and gradually extended themselves into the interior country. This is an observation made by many men in different parts of Connecticut. May we not, from this circumstance, deduce an argument that the *infection is imported*?

But these phenomena are not *new* in the world; they are new only to people who do not read. Avicenna, the Arabian physician, an author of great celebrity, says, that the "state of air called corrupt either impedes the growth of plants, or covers them with rust." Diemerbroeck, de peste, p. 40, 41, enumerates, among the effects of a pestilential air, the corruption of grain and fruits, the production of mice and noxious insects which corrode and devour the corn; the sterility of the earth, which fails to yield the usual quantity of grain and fruits." He takes notice also of another fact, which is, the unusual disposition to putrefaction in all kinds of fish, flesh, and vegetables, during

during pestilence. This putrefaction is by the moderns considered as a fruitful source of diseases. In some cases it may be so; but it is always an *effect* of the same cause which produces epidemics.

Another remarkable fact to prove the universality of the pestilential principle is the sickness and death of fish in rivers and the sea. Several examples are recorded in ancient history. See the years 590, 994, 1240, and others. The number, however, of such facts is not great in the old books; and whenever this phenomenon occurred, it was ascribed to frost, to a battle among the fish, or other improbable cause.

In modern times we have many examples recorded; but, probably, many others have escaped observation, or been considered as things of no moment to mankind; for, within a century past, the opinion that the plague is propagated in northern climates by contagion only, seems to have suspended all rational enquiries into the cause of the disorder.

That the fish on the British coast, or in the rivers, perished during the last great plague in 1665, I find no where related in a manner to render the fact certain; but I find Hodges has mentioned a fact of that sort, as a proof that pestilence is occasioned by an unwholesome vapour from the earth.

The

The death of the haddock on the coast of Norway, in 1789, has been already mentioned; but as there were many shocks of earthquakes in Scotland about that period, it is not impossible that the haddock might have been suddenly killed by some concussion of the water. A similar event took place on the American coast, in the great earthquake of November, 1755, when some whales and multitudes of cod were killed, and seen afterwards floating on the water. I throw all such cases out of the question, and confine myself to the sickness and death of fish, when there has been no concussion of the waters to occasion a violent death.

The disappearance of blue fish from Nantucket, in 1764, just after the great mortality among the Indians, is a remarkable fact. Not less singular was the sickness and extinction of the Wellfleet oysters, in 1775, the year of a fatal dysentery in America. Still more remarkable was the sickness or ill state of the cod fish taken on the banks of Newfoundland, in the year 1788. They were thin, unfit for use, and, when preserved, turned to a blue or dark colour.

Aristotle remarked, that no pestilential disease appears to affect all kinds of fish; but that these animals are subject to sickness, which is known by their being thin, and not changing their colours.

De Hist. Animal, lib. 8, ca. 20.

But

But to come still nearer to the present time. In the years 1793—4, the oysters on the coast of Connecticut and Rhode Island were all sickly, watery, and tasteless, and wholly unfit for food; and, in some instances, brought on nausea or sickness in those who ate them. This was the very time when the scarlatina was spreading over the country, with malignant dysentery and typhus.

The shad which came to New York market in the spring of 1796, which was the period of pestilence in New York, were leaner than usual, and perished, in defiance of the powers of salt.

In 1797 multitudes of small dead fish floated down James River in Virginia. It is remarkable that, in the summer following, all the country from Norfolk to Philadelphia, the very latitudes through which that river passes, was very sickly: Norfolk, Baltimore, Philadelphia, were all afflicted with the bilious plague.

I have been informed, that many dead shad were seen to float down the Susquehanna in June, 1798; but of the fact I have not satisfactory evidence.

The reader cannot fail to remark here the correspondence in place between the epidemic diseases in the water and the air; the fish and the human race, in contiguous regions, being diseased about the same time: a fact too remarkable to be permitted to escape particular observation.

The

The mortal pestilence among cats, in Europe and America, in 1797, is a fact too well known to be repeated. The sickly state of the water in the wells of New Haven, during the pestilential period of 1795, was evidenced by the number of animalculæ it contained.

Paracelsus mentions the death of fish, but ascribes it to the influence of the planets.

Vol. i. 167.

Sorbait relates that, in the time of the plague at Vienna, I suppose in 1679, a fountain in the suburbs, which had been esteemed for the salubrity of its waters, exhaled a stench which appeared to increase the mortality in the vicinity.—Van Swieten, vol. xvi. 47.—It is probable that Sorbait has mistaken the effect of this stench: it is probable that the great mortality in the vicinity, and the impurity of the water, proceeded both from one source, an uncommon effusion of subterranean vapour in that particular quarter, or other unknown cause.

All these phenomena denote a pestilential cause in water as well as air. Whether that cause is a positive substance, infused into the elements from subterranean regions, increasing the due proportion of oxygen; whether it is a negative state of the elements, occasioned by the abstraction of oxygen; or whether it is occasioned simply by a chemical alteration in the elements, by the me-

chanical operation of the electric fluid, which may produce new properties in air and water by means of new combinations of their parts, are questions not easily solved. But, without attempting to penetrate into the mysteries of nature, and unfold primary causes, we may be certain of their effects, and from this branch of knowledge may deduce useful conclusions.

We know, for we see, the effects of some mortal principle, which, at particular periods, destroys or impairs the usual powers of life through the animal and vegetable kingdoms. We rationally conclude that this cause must be general, affecting the elements of life over whole regions of the earth, and beneath the waters of the ocean. Of so much we are certain. As to the primary or remote causes we can only indulge a rational spirit of philosophical enquiry that may lead to probabilities.

Sydenham is among the most reputable authorities for the doctrine of a change in the properties of air from a subterraneous vapour. His words are, vol. i. p. 8, Wallis's edit. "There are various general constitutions of years that owe their origin neither to heat, cold, dryness, nor moisture, but depend rather on a certain secret and inexplicable alteration in the bowels of the earth, whence the air becomes impregnated with such kinds of effluvia as subject the human body to particular distempers, so long as that kind of
con-

constitution prevails, which, after a certain course of years, declines, and gives way to another."

The reader will recollect, that when the plague first broke out in Athens, the people alleged that the enemies had poisoned their wells. In the mortal plague of 1349, the Germans suspected the Jews had poisoned the wells, and vented their rage upon the harmless Israelites. These suspicions, doubtless, arose from the bad quality of the waters, similar to what was observed in New Haven in 1795; and the suspicion of poison was full as well founded as the modern doctrine of importation.

The death of fish in rivers and the ocean is one of the strongest arguments to prove the cause of pestilence to be a subtle vapour, expelled or exhaled from subterranean regions. That fish do, in fact, die of epidemic diseases, is a fact as well authenticated and as certain as that epidemic diseases affect the human race; and it is equally certain that such mortality among the fish is usually contemporary with pestilence among men on the adjacent shores. From these facts we are powerfully inclined to believe, the general cause which affects the one species of animals to be the same which affects the other species. This conclusion is easy, natural, and irresistible.

What, then, can be the principle which penetrates the waters, and reaches the animal functions of fish and oysters on the bottom of the sea?

Can it be a vitiated state of the superincumbent atmosphere? Can a deleterious principle, belonging to the air, find its way through a mass of water, and destroy life as effectually as in its natural fluid on the surface of the earth? These are questions I pretend not to solve. But I cannot help thinking that the only efficient cause, within our narrow comprehension, capable of extending the principle of destruction through the different elements is the all-pervading element of fire, or electricity. The *modus operandi* is among the impenetrable arcana of the physical world.

It may not be useless to introduce here an observation made by elderly people in America, that in sickly years the Aurora Borealis does not appear. It is certain, that during the present pestilential period, since 1790, that phenomenon has never been observed, at least not in any distinguished degree of brightness.

But the history of the Aurora Borealis does not warrant the justness of this observation as a general fact. The years 1564—5, which were distinguished by northern lights, were sickly in Europe, and in many parts raged the plague. The same lights were very splendid in November, 1575, a year when the plague was spreading over Europe with unusual violence and mortality. The same were repeatedly observed in 1580, the year of a most severe universal catarrh, when the plague raged in Paris, and when Cairo lost 500,000 people

ple by the same disease. Those lights were again visible in 1621, and described by Gassendus, in France, who, it is said, gave them the name of *Aurora Borealis*. That year was noted for a most fatal epidemic small-pox, and the Hungarian fever, in Europe; and the plague, which raged among the Indians in America in 1618, had not ceased in 1621.

From this time to the year 1707 we have no account of the appearance of these lights. In that year they appeared, but not of a remarkable brightness. If these lights appeared in this long interval, from 1621 to 1707, it is strange that astronomers should have left us no account of them. Certain it is, that the great Halley never saw this phenomenon till the year 1716, when he was sixty years old, and he began to despair of ever beholding it. During this long suspension of the *Aurora Borealis*, epidemic pestilential diseases occurred very often in both hemispheres.

In the same interval these lights were never seen in America; and our ancestors, when they first beheld them at the beginning of this century, supposed them a new phenomenon in creation, the memory of them having been lost.

In 1719, in November, appeared these lights, which was at the commencement of a sickly period of great severity and extent: the plague was then raging in the Levant. A splendid phenomenon of the same kind was observed in February, 1720,

the most unhealthy year of that period. The same in the three following years, and in 1725, 1726, 1728, 1730; repeatedly in 1733, a sickly period; repeatedly in 1735 and 1736, very sickly years, when the mortal sore throat prevailed; also in 1737.

From these facts we conclude, that the cause of pestilential diseases has no connection with these visible phenomena of the electrical fluid, as they are observed indifferently in healthy or sickly years. It is evident, however, that the *lumen boreale* is, in a certain degree, periodical.

Let us now attend to the effects of a pestilential state of air and water in the production of insects and small animals. This is one of the most remarkable symptoms of a sickly state of the elements; and it is more necessary to insist on this phenomenon, because it is visible to every eye, and carries with it, during pestilence, a demonstration of the doctrines for which I contend.

In the threshold of the history of plagues we meet with accounts of myriads of noxious insects accompanying these calamities. The ten plagues of Egypt are numbered among the miraculous interpositions of Providence in favour of his chosen people. But, so far as regards most of the plagues, we find, by subsequent events, they are usual occurrences during pestilential periods. Such are swarms of insects, called in Scripture flies and lice, and especially locusts; which at this day,
and

and in every age, are generated, in unhealthy periods, in such numbers as to darken the sun when on the wing, and which often devour every species of plants, and even the bark of trees. These animals seem to have their origin in the deserts of Arabia, bordering on Egypt and Syria; but they have often overspread all Palestine, Judea, and Italy. Sometimes they have penetrated into Germany, Poland, and Russia. It is unnecessary here to enumerate the instances related in the foregoing history of the ravages of these animals: the reader has observed that instances of their appearance have often occurred in different periods, and that they are always the harbingers or the companions of the plague.

This fact leaves no room to question, that the same state of air in the oriental regions which will generate epidemic diseases, will often produce those animals in unusual numbers. They do not, indeed, always attend the plague; the particular seasons most favourable to their generation is an excessively dry one; but it is obvious, that they rarely appear in desolating swarms, except in periods when the neighbouring countries are afflicted with mortal epidemics.

It is true that, in two or three instances, history informs us dreadful plagues have originated from the putrefaction of these animals—the instance of the pestilence on the African coast, about 126 years before the Christian æra, is

memorable. But while this fact is not disputed, we must observe that the same period was distinguished for pestilence in other countries, where no such local or particular cause existed. Great swarms of locusts, therefore, in the eastern countries, *may* be the cause of pestilential diseases, but always by accident; whereas, they are certainly the forerunners or companions of that calamity.

—See the years 394, 590, 677, 1031, 1084, 1091, 1186, 1234, 1337, 1476, 1646 and 7. Also before the Christian æra, the locusts of the years 206 and 174.

In the destructive pestilence which almost extinguished the human race, in the reign of the Antonines, about the year 167, the earth was overrun with caterpillars.

During a most mortal period, about the year 590, an inundation deluged Rome, and such multitudes of serpents were brought down the stream and lodged on the Champaign country, as to occasion a great stench, and contribute to the subsequent mortality.

Worms and myriads of flies, and other noxious animals, are mentioned in the foregoing history as the attendants on pestilence. See the years 763, 1001, 1106, 1234, 1286, 1348, 1390, 1575, 1598, 1610 and 12.

Lord Bacon informs us, that during a plague in his time, there were found in the ditches and low grounds about London, a species of animals
which

which he calls *toads*, with tails two or three inches long; a kind of animals, doubtless, which we often see in stagnant waters, but of larger size. He remarks further, that "those years have been noted for pestilential and unwholesome, wherein there were great numbers of frogs, flies, locusts, &c."

Works, vol. iii, p. 166.

Aristotle mentions the multitudes of frogs in sickly years.

Prob. sec. i.

Horstius informs us, that unusual numbers of frogs, toads, locusts, cankerworms, mice, snails, and similar insects, are the infallible signs of a pestilence. To these he adds an extraordinary abundance of fish in the sea and in rivers.

See p. 253, *de peste*.

The commencement of the present pestilential state in America was distinguished by an unusual plenty of shad, of which fourteen thousand were caught at one draft of a seine near the harbour of New York. I have met with one or two writers, besides Horstius, who have mentioned this phenomenon as the presage of pestilence, particularly Paracelsus, in vol. i. 168.

The plague of 1635 and 6 in Holland, was accompanied or preceded by an incredible number of insects, as gnats, butterflies, beetles, wasps,

wasps, grass-hoppers, but especially flies, which were so numerous, as to cover the ceilings of houses, and even to obscure the sun in open air.

See Diemerbroeck, *de peste*, p. 10.

In the plague of Laufanne, in 1613, flies were in similar abundance.

Ibid.

The approach of the plague at Dantzick in 1709 was announced by incredible numbers of spiders in the preceding year.

Baddam's Mem. vol. vi. 13.

The year 1633, which produced a pestilential fever among the settlers at Plymouth in America, was remarkable for swarms of large flies, which filled the woods with their humming sounds.

In the month of August, during a dreadful drought at Bengal in 1770, which cut short the rice-crops, and produced a terrible famine and subsequent epidemic fever, the air was filled with a cloud of insects, of the size of a horse-finger, with a long red body and a large head; they continued to obscure the sun for some days, during which all toads, frogs, and insects on the earth disappeared; but this cloud in the air did not descend to the earth. The next year a million of people perished with epidemic diseases.

The present pestilential period in America was introduced by such multitudes of canker-worms

and palmer-worms, as were never before known. Moskitos have been the harbingers and attendants on the diseases in New-York and Philadelphia in 1793, 1795, and 1798. In this latter year the whole country has been overspread with grass-hoppers, which very much injured the meadows, pastures, and gardens.

On these facts I will just remark, that they serve to confirm the historical truth of the scriptures. The whole series of facts relative to the great plagues that have afflicted mankind, is a tissue of proofs that the history of the ten plagues of Egypt was written on the spot, and is a faithful record of facts. If the operations of nature are uniform, the Scriptures cannot be a spurious production. They describe Egypt and Syria, as to every thing respecting climate and productions, precisely as they are at this day; and this fact is alone sufficient to establish their authenticity, against all the infidels on earth.

It may be impossible to define precisely those qualities of air and water which favour the production of unusual multitudes of any particular sort of insects. It has been customary for writers to ascribe them to putrefaction in the air; an indefinite and unintelligible term. It is true, that moskitos and some other insects are generated in hot, moist, stagnant air, and in marshy places, when the putrefaction of vegetable and animal substances is uncommonly rapid. But they are
produced

produced in pure water also, without any apparent mixture of vegetable matter beyond what is common to all water.

Flies, on the contrary, are most numerous in a hot and dry season. Moisture is hostile to their existence; and in the year 1795, when the rainy season commenced about the 20th of July, preceding the fever in New-York, the flies almost wholly disappeared, and were succeeded by mosquitos. Putrid substances are the food of flies, but the season most favourable to putrefaction does not always produce flies in the greatest numbers.

In short, it is not possible to account for the myriads of insects which appear in particular years, on any known principles of the animal economy, or any visible properties of air and water. If unusual numbers of a particular insect appear periodically, as in case of the canker-worms, though I have not satisfactory evidence of the regularity of *their* appearance in uniform periods, we should naturally conclude such animals to pass through other forms of existence, and to re-appear in a particular noxious form at the end of definite intervals of time. But were this the fact, it would still remain a problem of the most embarrassing difficulty, to discover the reason of their appearance in unhealthy periods only. For such is the fact with most of the insects; and their transmigration, if admitted, will not in the least help us to account for their existence in those

those times only when the state of the air is unfriendly to human life.

But, in truth, as to most of the noxious insects which mark periods of epidemic diseases, we know them not to change their forms of existence, nor are the times of their appearance periodical. On the other hand, we observe they appear in sickly periods, and in unusual numbers at no other time. We conclude, therefore, that a state of the elements, unfriendly to the health of man is favourable to the generation of noxious insects; but without attempting to explain the particular properties of the elements which possess that prolific power *. All I contend for by these facts is, that the pestilential principle, whatever may be its nature or properties, is a general principle, affecting all the elements of life, and that to this general cause are we to ascribe the deleterious diseases which at times spread over extensive regions of the earth. Under this just and philosophical view of the subject, infection sinks to a very trifling consideration among the causes of epidemic distempers.

The order in which insects and diseases appear is not uniform; but it usually happens that the insects are the first in order of time. This was the fact in 1770, when the flies clouded the heavens in Bengal, and the worms darkened the

* May it not be the force of excitement occasioned by electrical operations?

earth in America. Such was the fact in 1791, when canker-worms in June gave to our orchards the aspect of winter. But the whole progress of epidemics is more or less marked by noxious and troublesome insects.

If we attend to the state of a pestilential air, in respect to its effects on inanimate objects, we are furnished with further proofs, that epidemic diseases are the production, not of fomites from the sick, but of a general deleterious principle.

A remarkable instance of the corrupt or defective state of air happened in the mortal plague of the year 252. See the description of it under that year. It covered objects with what the historian calls "*ros tabidus*," a putrid or corrupt dew or mould. A state of air so extremely imperfect must have been utterly insufficient to support healthy life in the animal system.

The air of New York, in 1795, produced astonishing effects in the generation of mould, and the rapidity in the process of putrefaction in flesh and vegetables was almost incredible.

The fatal angina maligna among cattle, in 1682, was attended with a blue mist or dew on the herbage of pastures.

See the description of it under that year.

It is not an unfrequent thing, that a visible and offensive mist or fog arises in places during the rage of pestilential diseases. Such a mist arose

arose and spread over Dantzick in August 1709, during the plague. This fog was so thick as to darken the air for some time, and had a very offensive smell.

Baddam's Mem. Vol. vi. 14.

Schreibner, cited by Van Swieten, vol. xvi. mentions, that a small cloud often hangs over the infected place. It is suggested by that able author, that the contagion collected into such a cloud, may be dispersed by winds, and afterwards collect at a different place. It is, however, more probable, that such collections of impure vapour are produced where they exist; and that if once dispersed, the particles are not afterwards collected. The phenomenon, however, is no inconsiderable evidence that a pestilential state of the atmosphere is caused, or increased, by vapours exhaled from the bowels of the earth.

In the mortal pestilence at Rome, A. U. C. 576, Livy mentions a bow extended over the temple of Saturn, three mock-suns, and in the evening following many transient meteors.

Lib. xli. 21.

A similar fog or vapour during easterly winds appeared in New York, in September 1798, in the most fatal period of the plague. Persons who felt and saw it, describe it as most disagreeable to the senses; and its effects were very remarkable. The pavements of the streets; and
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other objects, were covered with a coat of dew, or mould, not however exactly resembling either of those substances; not unlike perhaps the "*ros tabidus*," or "*ros fanci similis*," of the year 252. Its effects were equally wonderful on the leaves of trees, which were covered with spots, which appeared as if corroded by an acid. And I have seen a cotton garment which had been washed and hung out on the night of the fog, which was also covered with spots of a dark grey colour, and which could not be taken out by any process of washing. During this period also, iron-railings and pump-handles were suddenly covered over with scales of rust, or a ferruginous colour. These phenomena correspond with the effects of the pestilential air at Oczakow in 1739, in which surgical instruments became livid or black, as did the silver hilt of a sword.

These recent facts, which have come under my own observation, have enabled me to give due credit to historians, who mention spots in garments appearing suddenly during the plague. The writers who mention this phenomenon were mostly monks, or other ecclesiastics whose relations are highly tinged with superstition; and as their imaginations have usually wrought up these appearances into the figure of a cross, or other chimerical form, and ascribed to them some miraculous qualities, I had passed over the passages with very slight consideration.

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I have however transcribed, or rather abridged, one of these accounts, under the head of plagues in the reign of Justinian. It is from Warnefred, who relates, that in the pestilence at Liguria, the Genoese territory, there appeared suddenly "*quædam signacula*," certain signs or spots on doors of houses, garments, and utensils, which could not be washed out, but grew brighter by washing. See the account in the foregoing history under the description of the plagues between 542 and 600. I recollect reading several other accounts of similar phenomena, which, for the reasons just assigned, I neglected to transcribe when the authors were before me, which I now regret.

The celebrated Boyle mentions similar phenomena during pestilence, and particularly an instance in Naples, in the year 1660, which happened after an eruption of Vesuvius, and which he ascribes to a vapour. The vapour, he remarks, made impressions of curious figures on garments; and he cites Thuanus and Kircher as authorities for his opinion.

See Vol. v. p. 60.

In the dreadful plague of 746 similar figures appeared on the garments of people, which the writer calls *cruciculae*, little crosses, which seemed as if drawn in oil. These marks excited no small terror wherever they appeared.

Paulus Diaconus. Aug. Hist. 1012.

These phenomena indicate a peculiar state of the air which is not common even during pestilence. It is a state which marks the highest degree of derangement in its ordinary healthful qualities, and such as, blessed be God, does not often occur.

Another strong proof of the doctrine here maintained of a pestilential principle in the elements, is the well-known fact, that, during the plague, fowls abandon the atmosphere of the infected places.

Livy mentions, that in the terrible plague at Rome, *Anno Urbis Conditu* 571, not a vulture was to be seen for two years.

Dr. Gottwald remarks, that in the Dantzick plague of 1709, sparrows, daws, storks, and swallows, deserted the place for four months. Dr. Schelwig has recorded a similar fact; and Storbait affirms that birds deserted Vienna during the plague. Those kept in cages died.

Diemerbroeck has informed us, that in the Holland plague of 1635 and 6, birds were unusually rare. He remarks, that birds more readily perceive the poisonous state of the air, and change their residence to places more salubrious, even abandoning their nests and their young. The same fact has been observed by many medical and historical writers.

The ancient physician and compiler of medical science, *Ætius*, mentions among the signs of approach-

approaching pestilence the death of birds and quadrupeds. If, says he, the circumambient air is the cause of the disease, it will first show its effects in destroying birds; if vitious exhalations from the earth are the cause, quadrupeds will be first affected.

The fact goes to demonstrate, that the pestilential principle pervades the aerial fluid, and is offensive to the delicate organs of fowls. It may be further mentioned, that the deleterious principle is often fatal to small birds in cages, before it is perceived by the human race. It is a curious and well authenticated fact, that in the progress of a plague, in cities, small birds sicken and die: and not long after, the people in the same house are seized with the pestilence. Diemerbroeck was frequently an eye-witness to the fact; and he observed, that wherever the small birds died in cages, the plague never failed, some time after, and often in two or three days, to attack the inhabitants of the dwelling. This is another proof, amounting to demonstration, that the pestilential principle is a quality of the atmosphere, and that it is *progressive in its malignity*, having little or no dependance on the powers of contagion.

See Diem. de peste. p. 11.

After all, the cause of violent and destructive epidemic diseases may remain a secret. We see

the causes of the ordinary diseases of the seasons in marshes, stagnant waters, confined air, and the like; but it often happens, that pestilence commits most cruel ravages in seasons apparently the most temperate, and in places evidently the most salubrious.

The plague in 542, and in subsequent periods of the fifty years plague of Evagrius, ascended to the tops of the hills and mountains. The terrible plague of 252, in the reign of Gallus and Volusian, invaded every village and every house. The deadly plague of 1348 penetrated likewise to the most healthy spots on the globe, and even to the regions of Greenland, sweeping away the human race with undistinguishing severity.

Hildanus informs us, that in the plague of Lausanne, in 1613, the huts of the peasants on hills and mountains were not exempt from the malady, though detached, and having no intercourse with the infected. The same fact is recorded of the plague in 1720, which extended to the villages and mountains of Provence.

In the *Traité de la peste*, p. 29, it is asserted, that in the melancholy plague at Lyons in 1628, the filthiest houses, the crowded places, narrow streets, and confined apartments, were places of the most safety; while the most airy situations, as houses on hills, were most exposed to the ravages of the disorder. No place was exempt—the change of air was useless or pernicious; in some cases,

cases, those who enjoyed health in the impure air of the city, on removing into the country were attacked with the malady. Malouin declares, that the most populous and dirty places in Lyons and Marseilles were least affected with the plague.

These facts are very singular, yet it is not difficult to account for them, on the principle of a superabundance of oxygen, stimulus, or principle of life in the atmosphere. If, as is supposed, a usual cause of pestilential disorders is a too great quantity of oxygen in the air, producing first the stenic or inflammatory diathesis, and of course indirect debility, then those places must be most healthy, in such a general state of the air, where there is the smallest proportion of oxygen. This remark, however, is a mere conjecture; and the facts related of the plague in Lyons, stand as an exception to a very general rule, that the most filthy, unventilated places, suffer most severely by all kinds of pestilential maladies*.

It is also true, in general, that the poor, who inhabit narrow streets and alleys, amidst filthy substances, suffer more by malignant complaints

* In Lyons, tanners and curriers escaped the plague, as did those who cleansed sewers and privies. The same has generally been the case with the sextons and others employed in burying the dead. See Lancisus, p. 160. In London, shipwrights, who laboured in the vapour of tar and pitch, escaped.

than the rich, who live in wider streets and more airy cleanly houses. To this, however, history presents us some exceptions; cases have occurred in which the rich have been the principal sufferers, as in 1361.

While it may be difficult to assign precise reasons for such differences in the operation of the principle of destruction, the facts prove that this principle consists in some hidden qualities of the elements, and does not arise from any of the ordinary visible causes of disease.

Riverius is explicit on this point. He avers, that pestilential diseases often occur without any apparent change in the visible qualities of the air, and when the air appears to be more pure than at other times, when no such diseases prevail.

Lib. xvii.

Further, although it is generally true that pestilence is attended, and greatly augmented in violence by some peculiarity in the seasons, as excessive heat and moisture, or drought, yet to this there are frequent exceptions. The reader may turn back to an instance of this recorded by Livy and other Latin historians, in which it was remarked, as a matter of surprize, that a violent plague, and one of the most destructive kind, should assail the city of Rome in a mild temperate season. A similar observation was made respecting the plague in Paris in 1580. The
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summer was temperate and the fruits good. No visible cause could be assigned for the malady. Yet a most certain, or rather an infallible symptom of a deranged state of elements, had occurred in that year; I mean a most severe universal influenza. Hence it appears, that although peculiar seasons may prodigiously increase, and perhaps produce a pestilence, yet the general cause is often some principle which has no dependance on seasons or changes of the weather. In the last London plague in 1665, says Hodges, the season was mild, the heat moderate, and fruit abundant and good.

We have in America proofs of the truth of this doctrine. The late pestilential periods commenced with the measles in 1789, and severe epidemic influenza in 1789 and 90, and has already continued nine years. Some of the summers, during this period, have been very temperate, as those of 1794 and 1797. Yet every summer has produced the pestilential fever of our climate; and even our winters have exhibited symptoms of the diseases which prevail in summer. Not one year, even the most temperate of the whole period, has failed to show the predominant diathesis of the pestilence. The sultry dry summer of 1793 and 98, and the sultry humid summer of 1795, have rendered the diseases more violent and fatal in the northern States.

Yet in the more favourable seasons of 1794, 96 and 97, the morbid cause produced its effects in New Haven, Providence, Newbury-port, and Boston, as well as in Baltimore, Norfolk, and Charlestown.

Hence we observe, that the elemental cause of the diseases of this period, may be in some degree modified, but not controlled or subdued by the most temperate and favourable seasons.

Indeed all writers of reputation on this subject agree in this one opinion, that the plague cannot be ascribed either to intemperate seasons, or to putrefaction, or to any species of exhalations from animal and vegetable substances. These are allowed to be secondary causes, operating to modify or vary the operation of the primary cause; but one uniform series of observations, from the beginning of history to this day, has driven medical writers from the defenceless ground of intemperate weather and putrid exhalations.

Hippocrates learnt that pestilence could not be ascribed solely to visible causes: he therefore admits *to theion*, something divine, or beyond human investigation, to be a primary cause of this calamity.

Tacitus informs us that the plague, in the time of Nero, could not be ascribed to any visible intemperature in the seasons.

Fermelius observes, that although immoderate heat augments the plague, and every acute disease,

ease, yet he had known an excessively hot season pass off without producing pestilential diseases. He agrees with Diemerbroeck, that the cause must be some unknown principle; "*inguinamentum e caelo demissum*;" some cause of corruption in the atmosphere, which is infused into it from the celestial regions. This is cutting the gordian knot. These authors are doubtless right in rejecting the visible qualities of the air, exhalations and intemperate seasons, as the primary causes of the plague; but they fly from the earth into the boundless regions of space for a cause which is more probably beneath their feet, or around their bodies.

Sennertus decides also most positively against putridity or corruption of the humours as the cause of pestilence; and maintains, that it proceeds from an occult malignity in the air.

Stenkus contends that persons do not receive the plague from humours in the body; from extraordinary seasons; from intestine putridity, or corruption of indigested substances; nor from bad food or drink; nor from stagnant waters; nor from exhalations from dead bodies, cemeteries or sewers; or the fetid waters of tan-yards, unless they inhale the noxious or infecting cause, *e sublimi*. To produce the malady requires no corruption of the manifest qualities of the air.

Prosper Alpinus, who lived some time in Egypt, and had an opportunity to make personal observations on the diseases of that country, maintains that the plague rarely arises from corrupt air, and never, unless when the Nile has exceeded its usual limits in its inundations. If, says this writer, the disease proceeded from noxious exhalations, from putrid stagnant waters and marshes, it would occur every year, which is contrary to fact. Hence he concludes the disease to be usually imported into Egypt from Greece, Syria and Barbary. In this opinion he has been followed by a whole tribe of unobserving travellers, who stupidly forget, that by tracing the distemper from Egypt to Syria, or Barbary, they never come nearer to its source. The question still occurs, what is its cause? Where is its source? If putrid exhalations in Egypt will not produce the plague, will such exhalations in Syria or Barbary produce it? Why trace it to these countries? Does any cause exist in Syria, Greece, or Barbary, to generate that disease which does not exist in Egypt?

To avoid this dilemma, some writers insist that its source is in Constantinople, where the seeds of it are treasured up in old clothes, and preserved from year to year, and from age to age. But why suppose this source of the disease to exist in Constantinople only? Why not the same source for ever exist in Egypt, for there
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also infected clothes are never purified. In short, from Prosper Alpinus to Mead and Cullen, all the reasonings and assertions of authors on the origin of the plague, argue either impotence of mind, want of observation, or extreme prejudice.

So far as this, Alpinus is right, that exhalations alone, from stagnant waters and marshes, will not ordinarily generate the plague; but aided by some general primary cause in the elements, such exhalations do produce the plague, and in no country more frequently than in Egypt.

Gibbon alleges this disease to proceed from hot, damp, stagnant air, drawing this conclusion probably from the origination of the terrible plague of 542, in the foul regions near Pelusium in Egypt, and in the vicinity of a large marsh. But if this were the only cause necessary to produce the disorder, as Alpinus justly observes, it would occur regularly every year, for every hot season generates putrid exhalations in ample abundance; and in every hot climate will be found annual returns of hot, damp, stagnant air. The causes therefore assigned by Gibbon are inadequate to the effect.

In America, beyond almost any other country, we have the most irresistible arguments against this opinion. No country on earth, not excepting the rice plantations on the river Bengal, presents such an immense region of
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stagnant waters, and fetid marshes, as the eastern shores of the United States from the Delaware to Florida. The southern extremity of this region is in a climate always warm; and the whole of it exposed to burning heat for four months in the year. Yet the true "*pestis inguinalis*" of the oriental countries, has never appeared in this country as an epidemic; and the species of the plague which occurs, and which I call bilious or *American*, appears as rarely amidst the marshes of Carolina, as in the northern cities, which are exposed to no marsh or exhalations.

Now, if hot, damp, stagnant air, and putrid exhalations alone were adequate to the production of this bilious plague, it must be produced every year in a multitude of places on the American coast; whereas, in fact, that disease rarely occurs as an epidemic, even on the flat lands of Carolina and Georgia, and never is very extensively mortal, except when the northern States, which are situated on high, rocky, gravelly, and dry lands, and whose air and water are of the most pure and salubrious kind, are afflicted also with malignant epidemic distempers.

This is a remarkable fact, and one on which I will venture to rest the whole argument. In no instance has the city of Charlestown, situated on an immense flat, surrounded by the marshes of Ashley and Cooper rivers, been severely troubled with a contagious bilious epidemic, except when the

the seasons have been sickly in the northern States. Witness the years 1699, 1728, 1732, 1739, 1745, 1748, 1796. I speak not of sporadic cases among strangers that visit the southern States, for these may occur every year.

The Europeans might, had they not been blinded by the false notions of contagion, long ago have discovered the same important truth; for what is called a great plague in Egypt or Syria never occurs, except during the prevalence of malignant epidemics all over Europe, even to the Baltic. Lighter epidemics occur in Egypt or Constantinople in any uncommon season, and so does the ordinary autumnal bilious fever in all our southern States. These are disorders which may be excited in any place and any season, by the action of heat on vegetable substances in stagnant water, or by the local impurities which always exist in populous cities. But these ordinary diseases do not put on the malignant symptoms which characterize the distempers of pestilential periods; they do not exhibit infection. On the other hand, when the diseases of Egypt assume contagious and deadly symptoms, and spread desolation over that country, we shall always find the northern parts of Europe more or less afflicted with the same or other malignant disorders. The pestilential principle, in greater or less degrees of violence, extends over
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the whole European world, and not unfrequently over the American continent.

Thus, although the plague does not in modern times appear in the North of Europe, at least not often, yet all the great plagues in the Levant are visible, if I may indulge the expression, in the augmented Bills of Mortality in London, Amsterdam, and the Baltic cities. Witness the pestilential periods of 1720, of 1736 to 1740, of 1760 to 1763. Even the less violent pestilences of 1772 and 73, and of 1784 to 1786, have been marked by epidemics in England and Scotland. And in the last series of epidemics, the years 1792, 93, and 95, which have been distinguished for the plague in the East, as well as anginas and plague in America, exhibit a considerable encrease of mortality in London.

All these facts serve as the evidence of the truth of what the medical writers of the fifteenth, sixteenth, and seventeenth centuries have unanimously advanced, that the primary cause of pestilence is some invisible quality in the elements, altogether distinct from corrupt air, or marsh exhalations.

It is a remark of the Arabian physicians, that an indisposition of the air is necessary in the hottest climates to enforce the action of putrid effluvia on the human body to produce the plague.

Mead, 248.

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Dr. Mead himself, while he maintains that the putrefaction of animal substances, with unseasonable moistures, heats and want of winds, produces the plague, and while he contends that no kind of putrefaction in European countries is ever heightened to a degree capable of producing the true plague, admits that a corrupted state of air is necessary to give the contagious atoms their full force, otherwise the plague could never cease but with the extinction of mankind. That is, he holds the plague never to appear in European northern countries without contagion; but that the contagion would remain inert without a corrupt state of the atmosphere.

The absurd opinion that the northern climates will not generate the state of air which occasions a pestilence, but that a pestilential germ or leaven must be imported from Egypt or other southern latitude, has been adopted by most of the British medical writers, and by a numerous part of the physicians in the United States. It is hard to say whether the followers of Mead are the more servile, or their opinion the more unphilosophical. But, for my present purpose, it is sufficient that even the advocates for the propagation of the plague by a specific contagion admit that this cause is not adequate to the effect, and that they are compelled to summon to their aid a general principle of corruption in the air to account for its propagation in northern climates.

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This concession of the existence of such a principle, by whatever name it may be called, is all I ask.

It is on this principle only we can reconcile the different accounts of authors in regard to the effect of putrefying bodies after battles in producing pestilential diseases; some alleging that such corrupting bodies will produce the plague, and others denying the fact. Julius Alexandrinus, Diodorus Siculus, and other authors relate, that plagues have arisen from the putrefaction of dead bodies after battles. Three or four instances occur in the foregoing history of plagues ascribed to the putrefaction of dead locusts. Forestus relates, that a dead whale, cast upon the shores of Holland, occasioned an extensive pestilence in Egmont.

See Hieronymus, Augustinus, Sabellius, Walsius, Angelus, Paræus and Agricola, who have recorded similar facts, as cited by Diemerbroeck, *De Peste*.

Dr. Gottwald relates, that the plague which spread over the North of Europe from 1702 to 1711, originated near Pickzow, soon after the unfortunate battle between the Saxons and Swedes; but he says nothing of putrefying bodies; nor does he ascribe the disease to that cause.

Baddam's, Mem. 6, 5.

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At the same time it is equally true, that thousands of dead bodies, after battles, have perished unburied without producing any such effect. In 1642 eight thousand dead soldiers, and innumerable carcases of horses, after a battle in the Duchy of Juliens, were left to putrefy on the surface of the earth, causing an intolerable stench, but producing no pestilential disease. The same fact happens often says Diemberbroeck, p. 31, in the cruel wars between the Swedes and Imperialists in his days; and we know that other historians have related similar facts.

Whenever a malignant disease follows such an extensive putrefaction, Diemerbroeck alleges the disease to be only a pestilential fever, but not the true plague. Or if in any instance the true plague follows, he maintains the putrefaction to be only a secondary cause. This is probably a near approach to the truth. The whole mystery is unfolded on my principles, which teach the existence of a disordered or pestilential state of the elements at particular times. If the putrefaction of dead bodies takes place during these periods, when the animal functions are debilitated or impaired, and the human body prone to disease, the corruption of flesh may so far vitiate the atmosphere as to produce pestilence. But if thousands of dead bodies putrefy on the earth when the air is in its natural state, salubrious and adapted to the support of health, and when the

human body is in full vigour to resist the effects of the foul effluvia, it is hardly possible for any quantity of dissolving flesh to evolve a poison adequate to the production of pestilential disorders, and certainly not sufficient to occasion an extensive epidemic.

An attention to this distinction will also reconcile all the differences of opinion, and all the contradictory phenomena which regard the effects of vegetable effluvia, and the impure air of cities.

Why, it has been triumphantly asked by the advocates of imported fomites, did not the filthy streets, and putrefying vegetables of New York and Philadelphia produce the bilious pestilence in former years? For many years we recollect more foul streets and docks; much greater accumulations of filth, yet these produced not the contagious fever which has lately desolated our cities.

Such are the facts, I admit, and the same will again take place when the period of pestilence shall be closed, and the latent disorders of the elements corrected. But there has existed since 1789 a universal defect in the healthful powers of the elements, clearly evidenced by a series of severe epidemics, the influenza and scarlatina, the increased violence of the symptoms of ordinary distempers; by the imperfection of fruits; by the sickness and death of fish, fowls, and cats, with many disorders among other animals. The mo-

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ment this state of the elements occurs, the local impurities which always exist in cities, and which produce only ordinary diseases in a healthful disposition of the elements, give to those diseases new virulence and a contagious quality. The whole secret to be unfolded is, that the autumnal diseases, under the debilitating operation of a general derangement of the elements, acquire unusually severe symptoms, a wider extension, and the quality of contagion, or what I call infection. These phenomena excite the astonishment of men who have not attended to the history of pestilence, in which they might have found the means of solving the difficulty; for similar facts have marked the progress of pestilential diseases from the days of Moses to this hour.

I would further observe, from universal observation it appears, that during that state of air which produces contagious diseases in unusual numbers, all kinds of flesh and vegetables are more apt to putrefy than in a healthy state of the atmosphere. This was observed by Diemerbroeck in the Holland plague of 1636, and we have had many proofs of it in America within a few years past. And this is evidently true, not only of fresh animal meat, but also of salted meats of all kinds. The powers of salt appear to be insufficient to preserve flesh and fish against the strong tendency to dissolution which seems to attend them in certain years. Hence we so frequently

hear of spoiled beef and pork; and fish, during sickly periods. In some seasons it appears to be almost impossible to keep provisions destined for foreign market. This effect on flesh and fish may proceed either from unusual heat and moisture in the air, or from an obvious imperfection or sickly state of the animals; and perhaps, independent of these causes, it may proceed sometimes from the same invisible principle in the properties of the air, which originates new and malignant symptoms of disease in the human body; a mere excess of stimulus.

But whatever may be the cause, the effect is obvious; and the unexpected putrefaction of salted meats has often been among the causes which have generated or augmented pestilential distempers in America. Such an instance is mentioned at New Haven in 1794, where a quantity of putrid fish was thrown into the dock, and was excessively offensive just before the appearance of the pestilential fever. In New York, the last summer, the pestilence evidently received great force and malignancy from large quantities of beef and pork which spoiled in stores and cellars. A similar cause is supposed to have excited or increased the same disease in Boston and New London. The putrefaction of the remains of great multitudes of the fish called menhaden, on the wharfs in Newbury Port in 1796, was obviously

viously a powerful exciting cause of the disorder in that town.

In such cases putrefaction is more rapid, and its stench more poisonous than under a healthful constitution of the atmosphere. This accelerated dissolution of flesh is the *effect* of the common principle of disease, and in its turn becomes the *cause* of disease.

Hence we may observe, that it is only during a sickly state of the elements that putrefaction is ever known to excite pestilential epidemics; for almost every man has observed many times, that the same quantities of putrefying flesh in periods of health produce no such distempers. It is this circumstance which has puzzled all superficial observers, and furnished the advocates of imported infection with strong ground to maintain their errors. They allege "the same causes have not always produced the same effects. As putrefaction and filth have not at other times, and always, produced diseases in our climate, therefore they do not produce the pestilential fever of the present time, and it must be occasioned by imported fomites." These men have not attended to similar facts in all other countries and in all ages. The same argument would prove that no pestilential disease can be generated anywhere; for it is as true of the West Indies, of Egypt and Constantinople, as it is of the United States, that putrefaction does not every year, and

at all times, produce pestilence. In this fact agree all authors who have written on the causes of the plague. And there is reason to believe with Diemerbroeck, that putrefaction *alone* never produces the plague; but that whenever it is the *apparent exciting cause*, there concurs with it a general sickly state of the air; which not being visible, mankind ascribe the whole effect to putrefaction.

In the United States it is a very curious fact, that this sickly state of the elements has been progressive, as I have particularly proved in the preceding pages, which progression was clearly marked by the increase of mortality, by the scarlatina, and other diseases of unusual malignity. In every instance, the epidemic pestilential fever, though said to arise from putrid flesh, has kept pace with this insalubrious state of air. For example, while Philadelphia was ravaged by the plague in 1793, the scarlatina was prevalent in New York; but the eastern States were exempt, and felt no inconvenience from the pestilential state of the air, unless in a few sporadic cases of autumnal fever, of augmented violence, which indicated a *commencement* of the epidemic constitution. In 1794, this constitution arrived to its crisis in Connecticut, moving eastward in its progress; and in New Haven appeared the pestilential fever soon after its precursor, the scarlatina. Now, whether we suppose the pestilence to be

be from imported fomes, or from the putrid fish and clams in the docks, it is remarkable, that it did not occur till the state of air was evidently sickly and ill-fitted to support life, as appeared by the malignant dysentery in the vicinity, and by the universal prevalence of scarlatina. This is a curious and important fact.

Proceeding eastward, we observe the same truth. The pestilential fever at Newbury Port was said to be excited by the putrid garbage of fish—true, but this effect did not take place in 1793, when the fever was laying waste Philadelphia; nor in 1795, when the same fever prevailed in New York. Why? evidently because the constitution of air in the eastern States had not then arrived to its crisis of malignity. But moving eastward, the scarlatina began to show itself in 1795, and in 1796 was more general and fatal in all the adjacent country. Then followed the pestilential fever, both in Boston and Newbury Port.—So if we admit the disease to be of imported origin, or suppose it to arise from putrid exhalations, we are still compelled to admit the concurrence of some general cause in the production of the disease, because we never know this pestilence to appear but when other diseases and phenomena demonstrate the existence of such a cause.*

With

* If it should be said, that putrid fish might not have existed in other years in situations to expose the inhabitants;

With respect to the duration of this general constitution of air, we can determine nothing but by the event. We observe in history, that such pestilential periods are of various lengths, from three to fifteen years, or perhaps for a longer time; during which diseases are multiplied and augmented, and all bearing some peculiar symptoms that characterize that constitution or state of the elements. On this subject the treatise of Sydenham is invaluable.

There remains one other view of this subject to be considered in this section—this is the connection of pestilential diseases with famine.

Most authors have remarked that famine is a cause of pestilence, and have cited the old Greek adage, "*o Coimos meta limon, pestis post famem,*" the plague follows famine.

It is a just remark, that the true plague often follows a dearth of provisions; it is more frequently true, that scarcity is followed by diseases of a less malignant type. But it is equally true, that this order is often inverted and famine follows pestilence. It is more frequently true, that pestilence is neither preceded nor followed by any scarcity of provisions. Instances of all these facts

I answer, that within my observations, in numberless instances, immense quantities of the entrails of fish are left to putrefy on the shores of our rivers every year, with an intolerable stench, but without producing the least appearance of disease.

appear

appear in the preceding history. The conclusion is inevitable, that the plague proceeds from some other cause than a deficient or superabundant quantity of food, for it often occurs independent of either of these circumstances.

Thus Morellus, de feb. pest. lib. 3, relates an instance, where no pestilential diseases succeeded a severe famine. Galen mentions an instance of a severe famine which followed a severe plague in Rome, yet the famine did not again excite the plague.

De Pauw, in his Philosophical Dissertations on the Egyptians and Chinese, vol. i. 87. answers and refutes the Abbe Fourmont, who alleged famine to be the cause of the plague. "By exact annotations," says De Pauw, "continued during twenty-eight years, we find the plague has raged in Egypt five times without being preceded by any scarcity of food, and, contrary to what I once suspected, unrestricted to a periodical course." We know also in America, that scarcity of food can have had no influence in producing the numerous epidemic and pestilential disorders of the last nine years.

On this subject Diemerbroeck has a very just remark, and one that solves all the difficulties that might seem to arise from the differing accounts of the effects of famine. He says, "*Non omnem, sed illam tantum famem sequitur pestis, quæ famem et ipsa a pestilentia causa originem*

sumit (dum ab ea causa primo fruges terræ corrumpuntur, postea pestis inducitur) ita ut fames illa non sit causa pestis, sed ipsamet eandem cum peste causam habeat."

De peste, p. 30.

" For the plague does not follow every famine, but that only which arises from the same cause as the plague, (for by that cause the fruits of the earth are first vitiated, and afterwards the plague succeeds) so that the famine is not the *cause* of the plague, but proceeds itself from the same cause."

Whenever there exists a general cause in the elements, unfriendly to the health of the human race, and at the same time to the growth and perfection of grain, pestilence and famine may be companions of each other; or they may reciprocally follow each other, according as the general cause operates first on vegetables, or on mankind. In such cases, superficial observers are apt to suppose one to be the cause of the other, when in fact, they are both the offspring of a common cause. In long sieges, bad food is often a powerful cause of disease, as in the siege of Marseilles by Julius Cæsar, before Christ 48.—Cæsar de bel. Civ. lib. ii. 20.—In such cases, the bad qualities of the corn or bread, are not natural defects in the growth, but the effects of age, heat, moisture, and decay.

Fortu-

Fortunately, the improved state of agriculture has rendered a dearth of grain a rare occurrence. In despotic governments, where industry of every kind languishes, and men seldom make provision for subsistence beyond the passing moment, famine is not unfrequent in modern times, as in Syria after the terribly severe winter of 1756—7, when the crops failed, and parents devoured their children, or offered them for sale in market to procure food. But such is the state of agriculture in free countries, that crops are less liable to fail than formerly; and when they fall short in a particular country, commerce may usually supply the deficiency from some other climate. A universal failure of grain, even under the most unfavourable disposition of the elements, must be a rare phenomenon.

Yet with all our improvement in agriculture and commerce, we are not to calculate with certainty that we are never to feel the scourge of famine. There has been, within about a century, a succession of seasons when the earth failed to yield her accustomed quantity of vegetable food. Such were the last years of the last century, when corn was cut short by mildew and blast, not in one country only, but in most countries. Multitudes perished in the north of Europe, and our forefathers in America observed, that for a number of years the very course of nature seemed to be altered.

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The beginning of the seventeenth century was distinguished by a still more extensive and severe dearth, which afflicted all Europe and cut off a large portion of its inhabitants.

In the year 1783, the dearth in Scotland was so severe that commerce alone saved thousands from perishing; and so late as the year 1790, our own country experienced a scarcity that excited universal alarm. Both of these periods were distinguished for severe famine in Egypt, Bengal, and the Carnatic.

Such facts show us the all-powerful influence of the invincible energies of nature, and how little avail human efforts, to avoid the fatal consequences of an universal failure in their operation. That the principles of vegetation do thus fail, at certain times, over large portions of the globe, is an unquestionable truth; it is equally certain, that such events are intimately connected with the cause of pestilence among men. Hence we observe, that men and cattle often perish with epidemic diseases when vegetables fail to yield their customary fruits.

It is not, however, the want of food which occasions diseases so frequently as the bad quality of it. Next to the corrupt state of air, says Riverius, unwholesome aliments are the causes of pestilent diseases. Vegetables may acquire unwholesome qualities from too much or too little moisture, or from other unknown causes. Grain
of

of a good quality may also degenerate and become unwholesome by heat and moisture, after it is gathered, as in magazines, granaries, or holds of ships. Such corn may produce diseases in those who feed upon it.

But it is doubtful whether mere want of food ever produced a contagious disease. Seamen who suffer, and even perish at sea in a wholesome air, through mere hunger, pine away and die without disease. Whenever contagious distempers accompany dearth, there is usually a concurrence of other causes to produce the effect.

We may therefore consider the proposition of Diemerbroeck as correct, that famine does not produce the plague, but proceeds from the same cause; yet that scarcity of food, and still more certainly, food of a bad quality, may produce diseases of a less malignant type, or very much augment, in violence and extent, the current disorders of a particular season.

Yet here again our senses may deceive us. Corn of an apparently bad quality does not always generate disease. A striking instance of this is related in Sinclair's Scotland, vol. vii. p. 605. Frost, rain, and snow, had turned the corn black; it was disagreeable to the taste; the straw was equally affected; but neither man nor beast suffered by feeding on them. So little do we know of the cause of diseases.

Intimately connected with the subject of vegetable nutriment, is the consideration of diseases among cattle. Whenever grass is defective in wholesome nutritious qualities, horses, horned cattle, and sheep, are sure to suffer by mortal distempers.

It is often mentioned in the foregoing pages, and a fact that every man may have observed, that when contagious diseases prevail among men, similar disorders prevail more or less among cattle. Very few of the plagues in ancient Rome affected one species of animals, without shewing the pestilential principle in others. The same remark may be made in all ages, and is true at the present period. Sometimes the pestilence invades one species of animals first, sometimes another; sometimes the diseases will be more general and severe among men, and sometimes among cattle: but seldom do we observe one species of animals severely affected, and the other totally exempt.

So far as my reading and observations enable me to judge, diseases among cattle usually succeed excessive or unseasonable humidity in the air. The years 1712 and 13, when a plague destroyed a vast proportion of the cattle in Italy, and great numbers in Germany, are noted in England to have been wet and cold. What was the state of the air in the countries where the disease was most fatal, I am not informed. The short account I have seen of it, abridged from

Ramazzini, in the sixth volume of Baddam's Memoirs, makes no mention of the weather or seasons; and Lancisus, who has also left many particulars respecting it, is not before me. The disease, however, was a true plague, characterized with many of the symptoms of plague in the human body. Authors all agree, that the distemper was propagated solely by contagion from a single cow, from Dalmatia; and they are so well contented with this idea, that they tell us little or nothing from which we can collect the cause. Like the writers on the cause of the plague in Egypt, who trace it to Barbary or Syria, and there leave the subject; so Lancisus and Ramazzini tell us the distemper, which destroyed most of the cattle in Italy, came from one cow, in a drove, from Dalmatia; and there they stop short, without a syllable to explain why the cow from Dalmatia was seized.

All these contagion sticklers resemble the Indian, who, when asked what the world stands on, replied, on an elephant—the elephant on a great turtle, and the turtle, on the ocean.—Here he stopped; and as to what supports the ocean, he leaves us in the dark.

The general visible cause of pestilential diseases among cattle, as before remarked, seems to be an excess of moisture, which renders their food watery and unsubstantial. The summer of 1751, a year of remarkable mortality among the cattle
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in England, was cold and rainy. Such was the season in 1348, which was followed by a great loss of sheep, as well as by pestilence among men.

Yet all wet seasons do not produce the same effect; and we are constrained to resort, for the cause, to unseen properties in the air, or the food on which the cattle subsist.—That the same general cause affects cattle and the human race, in times of pestilence, is obvious from the analogy of symptoms in their diseases. During the present sickly period in America, horses and horned cattle have died in many parts of the country, with diseases which are characterized with bilious appearances; in analogy with all the disorders which have affected men, during the same period.

Lancisus and Ramazzini would have treated the subject of the disease among horses and cattle in Italy, in 1712 and 13, much more like philosophers and men of sound science, if, instead of telling how much mischief an infected cow had done, and how the disease had been spread, by farriers, by dogs, and by shepherds, they had described to us the seasons, the state of vegetation, and the diseases which prevailed among mankind. They ought at least to have connected, with the disease among cattle, an extensive plague among men, which was then raging in Vienna, Hungary and other countries, as it had been for several years before, over all the Polish and Baltic territories.

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The frequent prevalence of mortal epidemics among the brutes, is an obvious and irresistible proof of some deleterious principle in the elements, which is adequate to the production of the worst diseases, and the destruction of life, independent of every artificial cause.

The brutes, if left to themselves, follow implicitly a principle of their nature, called instinct. They eat what nature intended for them, and never feed on what is pernicious to their health: nor will they injure themselves by eating too much or too little of their ordinary food. Governed by such a law, they can be liable to no diseases, but such as must necessarily proceed from the air they breathe, the water they drink, or the vegetables they eat; all of which are ordinarily good, nutritious, and well fitted to support sound health. Their diseases therefore must proceed from some imperfection in these elements of life, which is occasioned by natural causes. This process of reasoning appears to be strictly logical and correct. The conclusions from it are inevitable. If a state of the elements does ever exist, which can produce diseases that destroy the lives of the brutes, without contagion or any artificial cause, we may safely allege that a state of the elements may exist in any latitude which is adequate to the production of the most formidable maladies that ever affect mankind.

The analogies of the animal œconomy, and continual observations, forbid us to suppose the powers of life in the beasts of the field, less perfect, or more easily dissolved, than those of the human race. On the contrary, from their following their natural undepraved appetites, in the use of food and all their actions, their bodies may be supposed to be more firm and perfect than those of men, who are usually debilitated by irregularities in living, and other deviations from the laws of nature. If, then, irrational animals are subject to the invasions of mortal epidemic diseases, which mow them down by thousands, in defiance of the firm texture of their bodies, and their regular living, *a fortiori*, the human race must be liable to destruction by similar means.

This reasoning is certainly just and substantial, whatever may be its fate in convincing the reader: and it proves that the natural operation of some secret principle in the elements, is sufficient to account for the most destructive maladies, in every latitude on the globe, without resorting to the transportation of fomites from some one heaven-scourged country to more favoured regions.

Dr. Mead, and all his servile admirers who believe him without investigating his assertions, allege that putrefaction never rises in England to a degree that is necessary to generate a pestilence. But if any man can believe that putrefaction,

tion, as writers are pleased to call the principle of destruction, can rise high enough in the grades of malignity, to produce a plague or contagious mortal distemper among cattle in England, and at the same time never affect the human species, he must have more pride in the super-eminent station of man in the scale of being than I possess. The argument from facts is evidently in favour of the theory, which subjects all animals, in this respect, to the same laws; and the analogies of creation will not authorize man to claim the high privilege of exemption from the general laws of the animal œconomy. It is an unquestionable truth, that men as well as brutes, in all latitudes, are often invaded with contagious and deadly diseases, under the operation of the elements, without the least accession from southern climates, or any foreign country. Multitudes of facts warrant this deduction; but the progression in the violence of epidemic diseases, the imperfection of vegetables, the sickness and death of fish in rivers and the ocean, and of cattle on land, are proofs of the truth of my principle, which bid defiance to opposition.

SECTION XVI.

Of Contagion and Infection.

NO point on the subject of diseases has been more agitated among medical writers, than that of the contagion of the plague, inguinal and bilious.

Hippocrates has left no decisive opinion on this question; but those who maintain the plague not to be contagious, rely on this silence of the father of medicine as an argument in their favour.

Galen's opinion was clearly in favour of the contagiousness of certain diseases. "*Quodque periculosa sit conversatio cum laborantibus pestilenti morbo quum nimirum is non secus sit contagiosus, quam scabies aut lippitudo.*" * p. 379.

The author, doubtless, speaks here of other pestilential diseases, besides the inguinal plague, according to the practice of the ancients, who gave the name of pestilence to other malignant distempers, when epidemic. His opinion however was, that the plague originates in a putridity of air,

* In another translation, the latter part of this passage stands thus: "*Periculum enim est, ne concipiatur, ut scabies, et lippitudo.*"

inhaled by the breath. "*Lues ipsa, ab aëris putredine exorta, per inspirationes insiliens, haud unum aut alterum hominem, sed plures quoque civitates depascit, vastat, et populatur.*" p. 627. In another passage, he remarks, that pestilential diseases proceed from the atmosphere. "*Pestilentes morbi e cæli statu profisciscuntur.*"

This author observed, that pestilential epidemics must have some cause more powerful and extensive than contagion or infection.

Aristotle was clearly of opinion that the plague is contagious; and the reason he assigns why pestilence alone is communicated from person to person, is, that this is the only disease which is common to all men. This is not very clear or satisfactory; but he speaks of fomites proceeding from the sick, and infecting others.

See Problem. Sect. i.

Procopius was not a physician, but is esteemed as a historian. He alleges that in 543 the mortal plague in Constantinople was not contagious, and that physicians and attendants on the sick did not contract the disease.

On the other hand, Thucydides has declared unequivocally, that the plague in Athens was very contagious. Evagrius also has related, that the disease in his time was very contagious to particular persons, while others escaped, even against their

their inclination. Livy also was decidedly in favour of the doctrine of contagion.

Petrus Salius Diversus, cited by Diemerbroeck, was of the opinion, that the plague is sometimes contagious; at other times, not. Seneca held to the contagious nature of pestilence. So says Ovid, *Metamorph. vii.*

*Quo propior quisque est, servitque fidelius ægro,
In partem lethi citius venit.*

The nearer we approach, and the more faithfully we serve the diseased, the sooner we fall victims to the distemper.

Those who oppose the doctrine of contagion, not only produce as authority the silence of Hippocrates, with Avicenna, and other Arabian physicians, on the subject, but they allege, that if the plague was a contagious disease, it would *always* infect those who have communication with the diseased. But this they aver to be contrary to fact; and they instance the escape of many physicians, surgeons, grave-diggers, hearsemen and others. They argue further, that as the breath and effluvia of persons in health will not expel the poison of the plague from the diseased, so, on the other hand, the effluvia from the infected cannot infuse the seeds of the disorder into a healthy body.

Gregory Nyssen, a celebrated philosopher and theologian, concludes, that those who are seized with the plague after an intercourse with the diseased,

diseased, contract it from the same state of the air which occasioned the distemper in the sick, and not from the effluvia exhaled from the infected body. While I cannot assent to this opinion in the utmost latitude, I firmly believe it contains a great deal of truth.

Diemerbroeck, de peste p. 44, suggests that the ancient physicians, who passed over the subject of the contagion of the plague, called that quality only *contagion*, which communicates disease by immediate contact, as in case of the itch, leprosy, hydrophobia, and the like; whereas the plague infects more frequently through the medium of the air, vapours, garments, and other objects. Thus the sweat, exhalations, and excrementitious matter of the sick, corrupt the air; and this infected air becomes the means of disease to persons in health, who breathe it. This, says Diemerbroeck, the ancients did not call contagion, proceeding from the diseased; but they considered healthy persons taking the distemper through this medium as infected by the malignity of the air.

Almost all modern physicians, however, agree in the opinion, that the plague is a contagious disease, as Forestus, Prosper Alpinus, Diemerbroeck, Sydenham, and a multitude of others; and on this general opinion have been instituted quarantine laws, and other regulations for preserving cities and countries from the disease. Of the value of these regulations, we shall be the

better able to judge, after taking a careful survey of the question relative to the force and effects of contagion.

Within a few years, one author has ventured again to call in question the received opinions on this subject. Doctor Maclean, in a small treatise, has attempted to prove that the plague, dysentery and epidemic fevers, are never propagated by contagion. Contagion he defines to be a specific matter, generated in a person affected with disease, and capable of communicating that particular disease, with or without contact, to another.

This author's general arguments are these:—That specific contagion must necessarily act and communicate a disease from a sick to a well person, within a certain distance.—That in the plague, dysentery, and epidemic fevers, a small proportion of people, exposed to the action of the effluvia from the diseased, are ever affected by the distempers; and therefore such disorders are not contagious. He considers those diseases only as contagious, which can be received but once by the same person; as the small-pox and measles. He affirms that the existence of contagion in plague, dysentery and fevers, has been uniformly taken for granted, not only without proof, but even contrary to the evidence of numerous and convincing facts. He lays it down as a truth, that all epidemic and pestilential diseases,
which

which may affect a person more than once in his life, are caused by certain states or vicissitudes of the atmosphere, producing indirect debility.

The variety of opinions on this subject, argues either a want of accurate observations among medical men, or of accurate distinctions in terms. The various powers of diseases to communicate themselves, either have not been understood, or they have been imperfectly defined. Let them attend to facts, the only genuine source of knowledge.

First. We observe that the contagion of the measles and small-pox takes effect with great certainty, whenever a person in health, who has never been affected, approaches sufficiently near to a diseased person. I do not say it *always* takes effect; for there are a few exceptions; but these are so rare as not to impeach the generality of the fact or principle.

The contagion of the plague, dysentery and violent fevers, does not, under circumstances equally favourable, take effect with the like certainty. On the contrary, a great proportion of persons exposed to the effluvia of the sick entirely escape the distempers.

Secondly. The contagion of small-pox and measles is not sensibly affected in its operation by heat or cold, moisture or drought. It acts with the same certainty in winter as in summer, and in every variety of temperature.

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The contagion of plague, dysentery, and typhus fevers, on the other hand, depends almost entirely on heat for its activity, and is subdued, rendered inert, or totally extinguished by cold. Hence an essential difference in the two species of contagion—that of the small-pox and measles being an essential quality of the diseases; while that of the other diseases is an accidental circumstance.

Thirdly. The contagion of the plague often discriminates between the natives of particular countries, or men of a particular blood, or family, seizing one and passing by another, and this through the whole course of an epidemic; but the small-pox and measles make no such distinctions.

Fourthly. The contagion of the small-pox and measles is not destroyed by the purity of the atmosphere; it acts with the same certainty on the most salubrious hills, as in the most impure recesses of poverty.

Not so the contagion of the plague and dysentery; for, as a general rule, these diseases are not propagated in a pure atmosphere. With respect to the plague, some exceptions exist; but it is the usual fact, that these last-named diseases will not spread by contagion in a wholesome state of the air. By removing the sick from a city into the country, or otherways placing him in an airy room, and preserving it clean, with all the apparel and

and utensils, the contagion is so dissipated or attenuated, as to be rendered harmless; the attendants escape, and the disease is extinguished with the death or recovery of the patient.

Fifthly. The contagion of the small-pox and measles can never act but once on the same person. Its first operation destroys the capacity of receiving it a second time. The exceptions to this rule are too few to deserve consideration.

Totally different is the effect of the plague and dysentery; for, instead of fortifying the body against a second attack, these diseases debilitate the animal powers, and render the patient more susceptible of the contagion in a subsequent year. It is admitted by all correct observers, that the plague may be received by the same person, times without limits; a person in Constantinople died of the twelfth attack; and many persons in the late plagues in America have been affected two or three times. With respect to dysentery, and other contagious fevers, there is no controversy on this point.

Sixthly. The contagion of the small-pox and measles, if it takes the least effect, produces the disease complete. The infected patient may be affected more lightly than the infecting person; and the degrees of violence in the symptoms may be very various; but the disease produced will always be completely formed, and of the same specific

specific type as that from which it is communicated.

The contagion of the plague and dysentery has not the same certainty in its effect. The contagion of the plague very often produces only a nausea and vomiting—sometimes an inferior grade of fever, as an intermitting or remitting fever, of which I have myself seen examples—very often its effects are limited to dizziness in the head, or severe pains in the glands; and sometimes it has produced external eruptions, without any other material affection; as in the celebrated Diemberbroeck, who, in the grievous plague at Nimeguen, was affected with a carbuncle on his left hand, while in good health. In 1796, I saw an instance in New York, in which the infection of the pestilential fever had occasioned a singular swelling and inflammation in the face of a nurse, who escaped the disease.

Seventhly. We may perhaps add, what Diemberbroeck and other writers consider as essential to give effect to the contagion of the plague and dysentery, an apt or suitable disposition in the sound body to receive the contagion. Some peculiar state of a body in health is evidently necessary to the operation of the infecting principle of the plague: this is agreed by all authors. But it does not appear that any such state or disposition is requisite to give effect to the contagion
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of small-pox or measles, which act upon all bodies within the reach of their effluvia. This consideration may be the cause of the first distinction before recited; and a few exceptions exist to the proposition in regard to the small-pox and measles, which, though rarely, fail of operating on bodies in health.

These are the important distinctions, which, had they been observed by medical writers, would have prevented the enormous errors of Mead and others, who maintain that the plague is propagated, in northern countries, by specific contagion only. The truth is, the plague is a contagious disease, like dysentery, and most typhus fevers; but the contagion is *not specific*.

Specific contagion, I define to be, a quality of a disease, which, within a suitable distance, communicates it from a body affected with it, to a sound body, with great certainty, and under all circumstances of season, weather, or situation. Such is the contagion of the small-pox and measles. This contagion is of two kinds; first, that which acts by contact only, as that of the itch, leprosy, hydrophobia and syphilis; secondly, that which produces its effect, with equal certainty, by near approach; as that of small-pox and measles. The contagion of the angina maligna approaches to the specific kind; and if it is true, as some modern physicians have asserted, that persons can never be affected with it more
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than once, it comes under the character of *specific* contagion; but I doubt the fact.

That quality of the disease which may or may not excite it in a sound body, within a suitable distance, or by contact; and which depends on heat, foul air, an apt disposition in the receiving body, or other contingent circumstances, and which may excite the disease in the same person more than once, is certainly a very distinct species of contagion from that of the small-pox; and to this I give the denomination of *infection*.

With a distinction of this sort, which seems to have been first adopted by an eminent physician in New York, Doctor Baily, in his treatise on the fever of 1795, page 38, and which is unquestionably well founded, we have no difficulty in explaining all the phenomena of contagion, which have given rise to disputes without number, and to the most contradictory opinions. The plague, glandular and bilious, the dysentery, typhus fevers, and the milder kinds of angina, are not *specifically contagious*; but they are *infectious*. They will not, and do not, propagate themselves in all situations; but the operation of the infecting quality is controlled by a multitude of contingent circumstances.

First. It is admitted on all hands, that a suitable and particular constitution of air is necessary to render the plague epidemic in northern latitudes. Thus Sydenham supposes this disease to

to be conveyed by pestilential particles from one place to another, but not to become epidemic, unless favoured by the constitution of air. One ground of his opinion seems to have been a fact related by Mead, that when the disease has raged violently in one town, in the same climate, a neighbouring town has totally escaped, by forbidding intercourse with the infected place, as once happened in Tuscany.—This fact will be afterwards considered.

Mead also, while he declares his opinion, that the plague is spread by specific contagion only, like small-pox and measles, and that all plagues are to be traced to Egypt, very inconsistently admits that a certain corruption of the air is necessary to give the contagious atoms their full force.

These opinions are utterly incongruous; for if the plague possesses specific contagion, like the small-pox, then a corrupt state of air is *not* necessary to give full force to the contagion; for no such state of air is requisite to give force to the contagion of the small-pox. It spreads with as much certainty in pure air as in foul air. Mead's principles therefore overthrow his own theory. But he was driven to admit some general constitution of air to be necessary to the propagation of the plague, because he had learnt, from reading, that the plague will not spread in all places, at all times, and under all circumstances. In truth,
Mead

Mead never had an idea of the difference between the species of contagion; and the same may be said of most modern writers.

It is a most extraordinary circumstance, that the British authors, in modern days, should all agree that a favourable constitution of air is necessary to propagate the plague, and yet that no plague is bred in northern climates. They must and do admit, that such a favourable state of air has often existed in all parts of Europe: this is a kind of half-way business; allowing northern climates the power of creating and preparing a condition of atmosphere that shall meet the plague half-way.

But will it be denied that the petechial fever and angina maligna originate in northern latitudes? I presume not. Then the condition of air is admitted to produce *most deadly infectious diseases*, but not *the most deadly of all*. Kind heaven, in mercy to the northern world, has permitted the elements to generate diseases almost as bad as the plague, but not quite.

I then ask, does not the production of the angina maligna suppose as deleterious a principle in the air as that of the plague? Is not the disease as fatal to youth, and more certainly infectious or contagious? This cannot be denied. That disease destroys as great a proportion of patients seized as the plague, and is more certainly contagious to youth. Besides, this distemper
depends

depends not on local causes, but wholly on a condition of the elements. It therefore implies a most essential alteration in the atmosphere.

Further, if petechial fever is generated in northern climates, it demonstrates the power of those climates to produce the plague; for it has been proved that this fever is the same species of disease, and often turns to the plague. It has done this very often in England and on the Baltic.

Infection spreads certain diseases, and ought to be avoided; but medical men have ascribed ten times more effects to that cause than it ever produced. The same principle which generates the angina maligna, or plague in one instance, must be competent to produce it in all other persons of like disposition and habits.

Sanctorius, cited by Van Swieten, remarked that the rays of the plague may be removed by the wind; yet he was surprized to observe, that these rays from the body of a diseased person, are never disturbed by the force of the air. I do not perfectly reconcile these remarks; but it is an indubitable fact, that a pestilential state of air, when clearly and distinctly formed in a city, is not dissipated, nor very greatly affected by the most violent winds. It has sometimes been remarked, that the pestilential fever in American cities has been spread by particular winds; but it has spread

not only before but against the wind, though perhaps with less rapidity. Certain it is, that no force of wind whatever ever expels from a town, or lessens the pestilential virus, without the aid of other causes. Of this we have had repeated proofs in America.

Perhaps we may explain this fact, and reconcile the observations of Sanctorius on the principle I have unfolded, by supposing the effluvia of the sick to be in some degree capable of dissipation by the wind, which is undoubtedly true; but that the elemental cause of pestilence, which consists in the essential properties of the atmosphere, is not subject to dissipation or removal by the winds. This consideration would involve a curious question, viz. whether, in the apparent motion of air called wind, the whole mass of the surrounding atmosphere is moved? or whether it is the vapour or other component parts of the air only which are moved, while the fire or electric fluid remains stationary? But whatever may be the cause, the fact is certain, that the pestilential principle during a plague in a city or town, is never expelled by winds. A most violent cool North West wind swept the city of New York on the 19th and 20th September 1795, without any considerable abatement of the pestilential fever. This fact adds no small weight to my opinion, that the primary cause of such diseases is in the essential

essential combination of the component parts of the atmosphere *.

Sanctorius further observes, that “ things infected with the plague communicate the disease as long as the proximate and remote causes subsist, one of which ceasing, the infection ceases.” This is an explicit acknowledgment that the contagion is not *specific*, but dependant on some other cause, agreeable to the doctrine of Sydenham.

This principle is verified most remarkably in Egypt, as appears by all the authors who have written on the subject. They are all constrained to admit, even when they allege the plague to be not native in that country, that if imported at certain seasons of the year, it will not spread. Prosper Alpinus expressly declares, that the plague is *never imported in the months of June, July and August*; “ *nunquam visa est pestis illuc ex infectis*

* Warm southerly rains, however high the wind, usually increase the violence of the disease by inducing debility and giving activity to the local causes, as noxious effluvia from vegetable substances. Cool northerly winds, *accompanied with heavy rains*, lessen the morbid action of the pestilential principle; and if late in the season, and not succeeded by very warm weather, may entirely remove it. A violent tornado, with great rain on the 8th of October, 1797, was supposed to put a stop to the pestilential fever in Providence. Water decomposes the poison, or incorporates it into its own mass; but *heat* after moisture occasions a more rapid decomposition of vegetables, and increases the poison.

locis profecta;" although he maintains that the disease is almost always imported.

This is certainly a most extraordinary assertion, and unworthy of the reputation of the writer. What in the name of sense and consistency should prevent the seeds of such a disease from being "imported" in a particular season, when vessels are passing continually between that country and infected places? The idea betrays extreme weakness or prejudice.

Savary, in his letters on Egypt, has detailed the true state of facts. He saw vessels which arrived in Egypt from Turkey in the month of August, and landed their infected goods and people without communicating the disease. He informs us, that it is an observation of ages, that infected merchandize brought into Egypt in the months of June, July, and August, do not excite the plague but the disease expires of itself. If introduced at other seasons and communicated, it ceases; but if imported in winter, it spreads.

The author has here stated effects or phenomena with a good degree of accuracy; but has entirely mistaken the cause. It is wholly the state of air in different seasons, and not infection which occasions these varieties.

Mackenzie, in an account of the plague in Constantinople, though a firm believer in its contagion, declares "that both in that city and in Smyrna, the plague breaks out in some years when

when it is not possible to trace whence it is conveyed." This is doubtless true; yet neither this fact, nor the known fact, that contagion in Egypt will not operate in a certain season of the year, has ever opened the eyes of European authors to the absurdity of the current notions about the specific contagion of the disease.

A fact related by Patrick Ruffel in his history of the plague at Aleppo in 1760, is full to the same point, that the contagion of the plague will not take effect without the aid of other causes. In 1759 the disease was introduced into Limsol, a port on the South side of Cyprus, where it spread. Larnica, a town forty miles distant, received part of the infected crew which brought the contagion to Limsol. A constant communication was held between the two cities; peasants and mule drivers entered Larnica with their pestilential sores upon them, and were daily in the streets and markets. Some died in houses of the inhabitants. Other vessels also arrived with infected crews from Egypt; some of whom died on landing. Yet mark the issue—all this contagion did not excite the plague in Larnica. But in the beginning of the next year, eight months after, the disease appeared in Larnica without contagion, and made great havoc.

See Ruffel, page 4.

This fact and others compelled the author to admit that the disease is not always contagious, and that it does not become epidemic without a certain state of air. See pages 4, 5, 7, 17, 19, 307. These facts are of infinite consequence in directing the application of laws of quarantine; a subject to be hereafter discussed.

Innumerable examples may be produced of plague appearing in a few detached cases without becoming epidemic, and without extending itself by contagion beyond a single family. Often it appears in sporadic cases without exhibiting any contagion.

Fallinus relates an instance of a family in which the father, mother, with two children and a servant, died of the plague without glandular swellings, and without spreading the disease beyond that family.

Joubert informs us of an instance in 1574, of which a respectable family which lost half of its members by the plague, which ceased without spreading the infection. This was at the commencement of a most pestilential period.

Matthias Untzerus relates, that at Halle in Saxony he was an eye witness of instances in which here and there a family had been seized with the plague, introduced from other places, without any ill-effects in the rest of the city; the disease terminating in those families.

Diem-

Diemerbroeck observed similar facts. In October 1661, the daughter of a noble widow was seized with a violent disease resembling the plague in the midst of a town where no plague existed, and no foreign cause could be assigned for the disease. The servant who attended her died, and the infection extended to seven persons in succession; the rest saved themselves by flight. These persons died without the glandular tumours, and of course some of the attending physicians denied the disease to be the plague. Diemerbroeck, on the contrary, judging from all the symptoms, pronounced it the plague. It happened that one of the maid servants who left the family, and was going to her brothers at Amsterdam, was infected and seized with the plague, which soon put on the genuine marks of the disease in an inguinal tumour and two anthraces. She recovered, but infected two of her brother's children, and there the disease disappeared. No local cause could be assigned for the disease in that family. The plague was not before in the city or country; the house was a splendid, elegant one, and kept remarkably clean, remote from any filthy place, and had never been known to have an infected person in it. Hence our author concludes very justly, that a pestilential disease is not always epidemic, nor is any epidemic always dangerous; nor is pestilence necessarily common to many people; but that the

spreading of a disease by contagion is wholly an accidental circumstance.

See page 13, 14, of Diemerbroeck, *De Peste*.

On this last fact I will only observe, that the year it happened was 1661, the beginning of the constitution which produced the augmented violence of the diseases of London, as related by Sydenham, and the constitution which occasioned the plague in Holland in 1663 and 4, and that in London in 1665. It is to be regretted, that those able physicians and accurate observers had not extended their views of the subject to a prevalence of that pestilential constitution in various countries at one and the same time, instead of restricting their observations each to his own country.

The author of the *Traité de la peste*, who was a warm stickler for the origin of the plague at Marseilles in 1720 from importation, and wrote a treatise to prove it, has however demonstrated the contrary. He has admitted that the air of Marseilles was pestilential, and produced diseases marked with buboes and carbuncles in the autumn preceding its supposed importation. But this is not all; he has recorded facts which confirm all that has been cited from Alpinus, Savary, Ruffel and others, that the contagion of the plague will not spread the disease in an atmosphere not favourable to its propagation. He informs us,
that

that the disease spread from Marseilles in spite of all precautions, and infected more than fifty villages of Provence. This was ascribed to infected goods conveyed from Marseilles. Yet the surrounding provinces of Languedoc, Valais, Dauphiné and others, which he acknowledges to have been inundated with goods from the same city, escaped all infection. In Provence the distemper reached the inhabitants of mountains, and was not even arrested by the rigours of winter; while, in the adjoining territories, no person was affected, though equally exposed to infection. The author remarks further, that the disease passed over some villages, and infected others beyond them; for which no reason could be assigned, while all were alike exposed.

These facts were very surprising and unaccountable to the author, Chicoyneau; yet there is no difficulty in explaining them on the principle for which I contend; that the propagation of the disease depends entirely on the favourable state of the atmosphere, and not the least on contagion.

Almost all the supposed instances of infection from merchandize, related in authors, when investigated, are found to be mere suppositions and conjectures, raised and spread by vulgar credulity without the least foundation; and afterwards recorded as facts by medical writers, who are infinitely less excusable than other people. I have investigated many such instances in America,

where reports had become popular, and grown into such credit as to be generally believed and received as facts; and I have, in every case, found evidence amounting to demonstration, that these reports were idle surmises, very often puerile in their origin, and utterly unsupported by facts. Some of the received opinions, in regard to the imported infection of plagues in Europe, when subjected to careful scrutiny, prove to be equally destitute of foundation. Among these are the opinions received and recorded by grave writers, relative to the London plague of 1665, and that at Marseilles in 1720.

The supposition that the plague was conveyed from Marseilles into fifty villages of Provence by means of merchandize, appears to be no better founded. Setting aside the errors of vulgar tales in which such opinions usually originate, it is utterly against all probability, that goods sold from shops and warehouses should contain infection. If they are ever infected, it must be by being used by the sick; but the sick do not use the goods in shops and stores; they are confined to their rooms; and rarely indeed are their bedding clothes sent to market. Goods, the most susceptible of infection, as woollen and cotton, may lie in a store during the plague without any taint that can excite disease. In America we know this to be fact. In every town where the fever has prevailed, shops and warehouses filled with

with such sort of goods are open long after the disease has appeared, and until the air of the streets has become so pestilential as to excite the disease in a few hours in healthy strangers; nay, some of these shops are open during the whole time of the rage of our worst plagues; yet even cotton and woollen cloths have never, in any instance, contracted infection, so as to communicate the disease afterwards to those who handled or used them. I will venture to aver that all the reports in Europe about the propagation of the plague from town to town, and country to country by merchandize, are the offspring of vulgar tales. It is possible that garments *worn by the sick, and not cleansed*, may excite the disease in a sound body; but such garments, to retain the infection, must be closely packed in bales, chests, or boxes, or the action of the air will destroy the infection in a few days. And whenever an instance of this kind happens, the disease will die with the patient first infected. It will rarely or never spread, unless the constitution of air is so pestilential as to produce the disease without infection.

In these positions I am warranted by a multitude of facts related of European plagues, and many that have occurred in America.

Hence goods transported from Marseilles during the plague, did not communicate the diseases in Languedoc, Valais, or Dauphiné. The
true

true reason of the facts related by Chicoyneau, is, that the air of the whole country about Mar-seilles was pestilential, and affected most of the villages of Provence, although some escaped. Further removed from the sea shore in the con-tiguous provinces, the air was less pestilential, and the disease did not appear. Goods were conveyed to all these provinces indiscriminately; but they had no concern in the propagation of the plague. The plague appeared, where the pestilential principle was competent to produce it, the seat of which was at Mar-seilles, a large populous city; but which extended, as it always does, to some distance, beyond which it produced no plague. Wherever the distemper appeared, vulgar ignorance ascribed it to goods; and where it did not appear after the reception of goods from Mar-seilles, the vulgar and the learned all agreed they could not account for it; they won-dered that goods would not infect people in Languedoc as well as in Provence; and all the writers on the subject in Europe, from that time to this, seemed to have been satisfied with wondering at the phenomenon.

Of the truth of the doctrine that the plague will not spread from infection in an atmosphere not proper for it, we have in America most in-dubitable evidences.

In every pestilence that has affected our cities for six years past, great numbers of persons, when

when ill, have been removed into the country, or have been seized after removal; but not one instance occurred of the spreading of the disease in the country, to any extent, from such infected persons, until the year 1798. There have been a few scattering instances, in which the nurses of such persons have received the disorder. These have been very rare; probably not in one instance of a hundred, has any person been affected by fomities from such diseased persons. Most violent cases of the pestilence, when removed into a pure air, exhibit no infection that is perceptible. This fact corresponds with what has been related of the importation of infected persons and goods into Egypt in June, July, and August, which produces no ill effect; but for a very good reason; the air of that country, during the inundation of the Nile, will not *generate* the plague; and hence the vulgar idea, that it is not imported, or will not spread from infection.

But not only do our country people escape infection from diseased citizens, who sicken and die in their houses, but our cities also, when the constitution of air does not favour the disease, are not affected by the introduction of the worst cases from neighbouring cities. Thus in 1793, many persons from Philadelphia entered New York, in spite of precautions taken by the police, sickened and died in boarding-houses, and other places, but without communicating the disease in a single

single instance. In 1795, the case was reversed; New York generated a contagious fever, but Philadelphia did not; and several persons who left New York, sickened and died in Philadelphia without infecting any person whatever.

It is unnecessary to multiply examples; the same has happened between Philadelphia and Baltimore; between Norfolk and the adjacent country; between Boston and Providence; in short, there is not an exception to the remark, that infected persons, carried into towns and cities when the atmosphere has not been disposed to generate an epidemic, have never propagated the disease. In every case, and the instances have been very numerous, the disease has disappeared with the recovery or death of the first or second patient*.

But this is not all. In the same town or city, when the pestilence has been general in a particular quarter, another part of the town or city, situated on better ventilated or more elevated land, has not only been free from the epidemic, but has possessed an air capable of resisting the

* In 1798, the first cases of the fever in Chester and Wilmington, originated from Philadelphia; but the atmosphere also of the country in New Jersey and Delaware, actually generated the disease in the neighbouring districts, and so it did in Connecticut.

infection of the diseased. This, to a certain degree, was the fact in Philadelphia, where no part of the city can be called elevated; yet in 1793, and 1797, few cases of the fever occurred in the western part of the city. But in New York, New Haven, Providence, New London, Boston, and Newbury Port, the disease has had its pestilential region, or quarter of the town, in which it became epidemic and infectious; but other parts of the town have been free from it. And in all such instances, the most malignant cases in persons seized in the pestilential region, and conveyed to the healthy part of the town, have exhibited no infection; or if a single nurse has taken the disease, of which I have heard of two or three instances, the infection has there ceased, and produced no further effects.

These exempted parts of the towns are the more cleanly and airy situations. To this, however, occur two exceptions. One in Philadelphia, in 1798, the disease of which year was more virulent and more infectious, than in former years, and extended to healthy positions. The other exception is in New-London, the last summer also; in which town the disease had indeed its pestilential region marked distinctly, as before related; but this part of the town where the disease raged, is as airy and well built as any other quarter.

Evagrius

Evagrius remarked of the plague in his time, that it sometimes attacked certain parts of cities, and left others untouched.

See the year 590.

Pestilential diseases then have an atmosphere in which they rage with violence; but at a distance they lose the power of infecting, at least to a great degree. Van Swieten remarks this of the spotted fever in 1756—if healthy persons descended into the valleys where it was prevalent, they took the disease; but when removed into more airy situations, they infected no one.

Vol. xvi. page 59.

These facts all concur to establish the principle, that some other cause must act with infection, to render this pestilence epidemic, or to give it effect. The consequence is unavoidable, that the infecting cause is *not a specific contagion*.

In the second place, the infecting power of the plague, and other autumnal diseases, is susceptible of gradation from the lowest point of danger, up to the highest; a circumstance that does not characterize the specific contagion of small-pox and measles. In America, we have seen the disease in every stage of virulence, except, perhaps, the very highest; like that in the days of Gallus and Volusius; that in the time of Evagrius; or that

that in the reign of Edward III. and a few others. The disease in Philadelphia, in 1797, was more infectious than that in 1793; and that in 1798, still more than either. The fever in New York, in 1795, exhibited very little infection, not one case in twenty proceeding from any communication with the sick; but in 1798, the disease put on a more virulent aspect, and was more generally infectious. In Baltimore, the disease in 1797 ran through all the grades of bilious fever, from an ordinary remittent, which for weeks prevailed without infection, to a contagious yellow fever.

But this is not all. During the same season, in the same city, the disease exists in all its grades, from an intermittent to the contagious yellow fever. It is a very frequent thing for persons seized with decided symptoms of the pestilential fever, to have the disease reduced by early applications to a remittent, or intermittent. Of this I am an instance myself; having contracted the malignant fever in New York, in August 1798, from the air of the city, for I was near no diseased person, and returned home, I was seized with the symptoms, though not of the most violent kind. The fever was disturbed by early remedies, and I became convalescent, but in a few days I relapsed, and the fever took the form of a regular tertian. Dr. Rush relates similar examples in the fever of 1793.

Lind, on diseases of hot climates, p. 179, remarks, that patients, with a mild intermittent, sent to Greenwich Hospital, near a marsh, in Jamaica, soon grew worse, and their disease turned to a malignant yellow fever, or mortal dysentery.

A multitude of such facts have been observed in America, which, with the remarkable history of the disease in Baltimore, in 1797, seem to amount to a demonstration, that the plague and all autumnal bilious disorders, are of one species, differing only in their grades. Indeed the writers on the Levant plague, while they utterly deny such a sameness in kind between that disease and any other, have recorded facts to prove the doctrine here maintained.

Patrick Ruffel admits, that the plague in Aleppo was of very various degrees of malignity, and was not always infectious. He has even arranged the cases in several distinct classes, according to the various symptoms and degrees of mortality.

Lady W. Montague, in letter thirty-one, has the following observations: "Those dreadful stories you have heard of the plague, have very little foundation in truth. I own I have much ado to reconcile myself to the sound of a word which has always given me such terrible ideas; though I am convinced there is little more in it than in a fever." She then proceeds to relate, how

how she passed through several infected towns, that her cook was taken ill, and she was told, with a cold—that she left her doctor to attend him, but the cook soon recovered; and both cook and doctor, in a few days, arrived in health at Adrianople. She was there surprized to learn, that her cook had been ill with the plague. She concludes from her own experience, that the air is never infected, and that it is as easy to root the plague out of Turkey, as out of Italy and France*. She remarks also, that “many escape it”—which is certainly wonderful!

Just so carelessly people reason and draw conclusions from a single cursory observation, or an isolated fact; a practice among travellers, as among men of pretended science, which is the source of numberless errors. It is undoubtedly true, that the plague is often “little more than a fever;” but if Lady Montague had been in Cairo in 1580, or in 1736; or in Constantinople in 543, or in 1751; or in London in 1665; or in Marseilles in 1720, she would have thought the plague something more than an ordinary fever. The truth is, the disease exhibits different grades of violence at different times.

* Notwithstanding this disease was “rooted out of France,” it happened that, in two years after Lady W. Montague wrote her letter, Marseilles was almost depopulated by the disease!

Savary remarks, that such as *catch* the plague in Egypt in June, July, and August, are always cured.

So observes Mignot, in his History of the Turkish Empire, vol. ii. p. 4. "The plague, at certain times, is incurable; at others, easy to be cured. The contagion is more or less strong, according to the state of the air."

Similar remarks occur in the *Traité de la peste*. The author is full of his idea of the contagion, but he says, the plague, though always from one cause, appears differently in different places, and a small distance between them makes it appear like two different diseases, as at Montpelier and at Lyons.

Chandler, in his travels, gives us wonderful discoveries on this subject. He says, the disease proceeds from certain invifible animalcules burrowing and forming their nests in the human body. These are imported annually into Smyrna—they are the least fatal at the beginning and latter end of the season. If they arrive early in the spring, they are weak, but gather strength, multiply, and then perish!!

Such filly opinions are gravely recorded in books, yet they prove that infection is of very different degrees of strength, or that it is the state of the air, and not infection, which produces the disease.

P. Alpinus, followed by Volney, Savary, and others, speaks of this difference in the malignity

nity of the plague; but he ascribes it to the *place* where the disease originates. He says, the contagion from Barbary is more putrid and virulent, than from Greece and Syria, and instances that of 1580, vol. iii. p. 61 and 2.

It is true that some of the most violent plagues have first appeared in Ethiopia and Barbary, as in the time of Thucydides, in 252, in 1580, in 1736; but these writers ought to have recollected that others equally violent have originated in Egypt, in China, in Italy, and in Constantinople. Witness that in 542, which began near Pelusium, in Lower Egypt; those of 1347, and of 1450, which began in China, or other parts of Asia, and that of 745, which commenced in Calabria, in the kingdom of Naples.—They might have observed also, that many plagues, of the most destructive kind, have appeared at once in twenty or more cities of Europe. These considerations would have detected the puerility of the notion, that contagion from one country is more “putrid and virulent” than from another, and led the observers of nature to the true cause of these different grades of malignancy, different states of the atmosphere in different periods.

Fernelius divides epidemics into three kinds: an epidemy from exhalations or vapour from the earth; from great changes of seasons; and from an occult malignant quality in the air; the last, he maintains, is the only true cause of the pestis;

the others are preparatory to it; but these causes often unite, and the plague then becomes most severe. Putrid exhalations do not alone produce the plague, but prepare for it and aid its progress. Hence it does not affect all places or all men alike—but is most severe in maritime places, in those exposed to the south, warm and humid, abounding with impure exhalations.

De Morb. Pest. 189.

There is a great deal of truth in these observations, and I cannot but remark how much more correct those authors are, who often saw the plague, than Mead and others who had no such advantages.

The violence of the pestilential principle, aided by seasons remarkably debilitating, has sometimes dispatched the human race with terrible rapidity. The more usual course of the plague is from five to seven days, when death, or a favourable crisis, takes place. But to this there have been some dismal exceptions. The disease described by Evagrius, in 590, generally put an end to life in three days. This also was the period of the crisis in the dreadful plague, in the days of Vortigern, in 448, and the subsequent years. In the similar calamity of 1348, few patients lived beyond the third day.

In many instances, during these more general plagues, persons have died suddenly, as in an apoplexy;

apoplexy ; as in the pestilence at Narbonne, in 1534, where men frequently fell dead as they were walking or conversing ; of which Stenkius himself was often an eye witness. He cites as authorities for the same fact, Valleriola, Gemma, Salius, and Cardanus. See page 765.—The same happened in the pestilence described by Evagrius ; and authors relate that no less than eighty persons fell dead, in a procession, instituted by St. Gregory, about the year 590*.

Dion Cassius mentions an expedition of a Roman army into Arabia-Felix, in which most of the soldiers perished by unusual distempers. Many of them were seized in the head ; the brain dissolved, and the disease falling upon the throat, suffocation speedily ended life.—This was evidently the effect of extreme heat, producing excessive excitement, and soon followed by a total debility of the nervous system.

Terrible indeed must be that virulence of the pestilential principle, which bids defiance to cold. Yet such has been the case in a number of plagues. In the pestilence of 543, says Procopius, the disease invaded some places in summer, others in winter. Evagrius makes the same remark of the

* This disease sometimes attacks in the form of an apoplexy ; in other cases, persons are indisposed for some days, but able to walk, while the disease is secretly undermining the animal powers. Such persons suddenly pass from apparent health to their graves.

plague in 590. The black pestilence of 1348 attacked countries, in northern latitudes, in winter or summer, without discrimination. The disease in Provence, in 1720, was not controlled by the rigours of winter. The pestilence in 1591 raged through a cold winter, in Revel and Narva, in the 59th degree of North latitude. "Sometimes, says Fernelius, the most intolerable heat of summer produces no pestilential disorder; at others, the plague breaks out in winter, and ceases in the midst of summer, or in autumn."

Page 189.

Diemerbroeck remarks, that a plague which begins in winter, or autumn, is more violent, and of longer duration, than one which begins in other seasons. So says Peter Paschal, an author cited by Diemerbroeck; the plague which begins in spring or summer, ends in winter; that which begins in autumn, or winter, is of longer continuance.

The reason of this diversity is very obvious. The pestilence which appears in winter, in northern latitudes, can proceed only from a disposition of the atmosphere; for cold totally destroys all infection of that disease, and all the influence of putrid exhalations. Whenever therefore the plague invades man in cold weather, it demonstrates a *more malignant* state of the air, and one that is not controlled by cold weather or frost. Such a
state

state of the air must of course produce more fatal effects, than an inferior force in the pestilential principle, which perhaps requires the aid of heat, humidity, and noxious exhalations, to produce a very violent plague. Thanks to heaven! most of the pestilences that afflict mankind are of this latter or subordinate degree; in which the real plague is limited to places highly charged with morbid substances, which it is in the power of man to dissipate or remove.—A vast proportion of all pestilential diseases are found to rage only in cities, jails, camps, and crowded ships, and may be avoided or mitigated by human means.

At the same time, historical facts warrant me in believing that the pestilential principle does, at times, acquire a virulence that proves fatal to life, in every season and every situation; assailing, indiscriminately, the city and the cottage; the cleanly dwellings of the rich, and the filthy cells of the poor; the highest hills, as well as the vallies; the borders of morasses, and the nauseous allies of a populous town. During this melancholy state of the elements of life, and such was their condition during the ravages of the black pestilence in the reign of Edward III. men are, however, not to despair of preserving life; but the means consist in applications to the human body, calculated to guard, not against infection so much as against *debility*, the deciding proximate cause of the malady.

Historians

Historians mention a remarkable difference in the operation of the two very furious plagues in 1348 and 1361. That of 1348 was most fatal to the poor; but that of 1361 was most mortal among the nobility and gentry, and on hills and mountains, which usually escape. In the first place then, morbid exhalations constituted an influential cause in propagating the malady—in the latter case, they operated as a shield or antiseptic—and the facts demonstrate the various force of the elemental causes.

In the third place, to give effect to the infection of the plague, and at times to other autumnal diseases, there must be an apt or suitable disposition in the human body. This is admitted by Hippocrates, who observes, that body differs from body; the nature of one man, from that of another; the nutriment of one, from that of another; and the same things are not alike pernicious to one species of animals, as to another. Hence he accounts for diseases invading one kind of animals at one time, another species at a different time, and different species having their various distempers.

Lib. de Flatibus.

Thus Galen remarks, that the same causes do not affect all persons alike; if they did, violent heat, excessive fatigue, or drinking, or anger, or grief, would produce fever in every person; and

for the same reason, all persons alike would be seized with pestilence during the reign of the dog star.

De di. feb. cap. iv.

In conformity to these ideas, Diemerbroeck, p. 50, lays it down as a principle, that no person will receive infection, unless his body has an *aptitudinem*, a fitness or disposition to receive it, arising from some secret quality or bad state of the system.

On this point, we reason without knowing causes; all we can do is to collect and arrange facts, which decide in favour of this hypothesis. We are compelled to admit the principle, not only as it respects the operation of infection, but also of the elemental or primary atmospheric cause of pestilence, which makes an evident distinction, at times, between persons of different habits, families, and nations*.

These facts come under the observation of Procopius and Evagrius. In 543, says the former,

* Medical men are not agreed as to the nature of what is called *predisposition*. Brown, in Elements of Medicine, defines it to be a less degree of the disease; that is, the commencement of the disease. I suspect this definition, properly limited, to be nearly just. It is probable that all fevers are the effects of debility, and that when this debility commences, a person may be said to be *predisposed to disease*; although the disease may not be formed in many days or weeks after, or may be prevented by early applications.

no physician or attendant caught the distemper—while many were seized, they knew not from what cause, and suddenly died. Many, says Evagrius, who fled from infected places, remained safe themselves, while they communicated the disease to others. Many who remained with the sick, and freely handled them, wholly escaped. Others, in despair for the loss of friends, threw themselves in the way of infection, but were not able to contract the disease; while others received the disease by the slightest connection with infected houses, or in open market.

We have many memorable examples of a similar nature in America—they are too numerous to be specified. I suspect, however, that four-fifths of such cases are improperly ascribed to infection.

Diemerbroeck relates, that in the height of the plague at Nimeguen, the air was so bad, that all places were nearly alike, as to the danger of infection; persons received the disease with or without intercourse with the sick.

Sometimes the plague discriminates between natives of different countries. The French fugitives from the West Indies, who have resided in our cities during pestilence, have generally escaped. This is not, however, very remarkable, as they are accustomed to a climate which is, like our summers, peculiarly fitted to produce a similar disease; at the same time, their manner of living is

is better suited to the warm season, than that of our own citizens.

But a similar discrimination has been often observed, among natives of the same latitudes, or nearly the same. Thus Cardanus, Lib. viii. relates, that in a pestilence at Basle, the Swiss only were affected; the French, Italians, and Germans, escaped.—John Utenhovius relates, that in a plague in Denmark, all strangers, as English, Germans, and Hollanders, escaped; although they resided in families, and associated freely with the infected. The *Sudor Anglicus*, when it first appeared in England, attacked none but the English; but in subsequent pestilential constitutions, it invaded almost all Europe.

We have in America most illustrious examples of the distinction above-mentioned. In the sweeping pestilence of 1618, when almost all the Indians perished, on a tract of three hundred miles in extent, some white men wintered in the country, and associated freely with the sick, without injury. In a similar pestilence among the Indians on Nantucket, in 1763, not a white man was affected, though never so much exposed to infection. Two or three instances have come to my knowledge. A like discrimination took place in Egypt, in the time of Moses.

Sometimes the plague singles out particular families. Thus Diemerbroeck observed in the plague at Nimeguen, whole families, by a secret sympathy,

sympathy, were seized all at one time; and in some instances, where the members of the same family lived at a distance from each other, in different parts of the city, they were all attacked nearly at the same time. What is more remarkable, the same fact was repeatedly observed, when the members of the same family lived in different towns. Of this there were many examples. One man, by the name of Vans Daus, to preserve his children from infection, sent two of them to Gorcum, in Holland, to reside with his friends, and kept the third at home. There was no pestilential disease at Gorcum at that time, and the two children remained in health for two or three months; but at last both were seized with the plague and died, at the same time that the father and another child died with it in Nimeguen.—The mother was seized, but recovered. About the same time, a sister, and two or three other children residing with another sister, at a distance, and several more remote relations of the family, all perished with the same disease.

So it is related by Evagrius, who was surprized at the fact, that particular families, sometimes only one or two, were arrested by the plague, while all the other inhabitants of the city remained in health. But he remarks further, that those who escaped the first year, experienced the like calamity in the next. This fact, by the way, is common, and should have led Evagrius and others

others to observe the progressiveness of the pestilential cause.

Pliny, Lib. vii. cap. 1. remarks, that old people are usually exempt from attacks of the plague; but that all nations are subject to pestilential diseases, which invades them by kinds or classes; sometimes falling on servants, sometimes on nobles, and on others by grades or ranks. Nature, says this author, has even prescribed certain laws to diseases. The last remark should have excited the minds of physicians to discover these laws. Such laws certainly exist, and epidemics of all kinds are connected in principle.

I have met with other instances of discrimination, perhaps more remarkable. One is related from John Helurgius, in Bonetus. Collection of Northern Medicine, p. 228. In 1621, when the small-pox raged with great mortality, it was remarked that persons of the same blood, as brothers, cousins, and other relatives, living at a great distance from each other, and as far as from Nuremberg to Lyons, in France, were seized with the disease at one and the same time.—I draw no important consequences from this fact, because this disease is not *limited* to particular families, although it may seize one family before it does another.

Another instance is related by Van Swieten, vol. xvi. from Heister, an author of undoubted credit. At Altdorf, in Franconia, broke out in

1711,

1711, a malignant fever, approaching to the plague in violence, but not with the glandular tumors. This disease attacked none but the students or others of the university; but it seized them wherever they were dispersed, in private families, in all parts of the town. It seized the professors also, and their families; but went no further by infection. It attacked also the printer to the university, and his workmen, though at a distance from the college; while another printer, contiguous to the college, escaped. Students also belonging to the university, though at home, as at Nuremberg, were seized. It was thus restricted in its attacks, and exhibited no infection beyond these descriptions of persons.

It must not be omitted, that this was a very sickly period in all the north of Europe. In this same year the plague raged in Copenhagen, and it had, in the preceding years, spread over Poland, and along the Baltic.

This fact at Altdorf is by far the most singular that I have found in history; but that a violent disease should attack persons of one blood, and not of another, is less surprizing. We have recent proofs of this discrimination in America. In 1796, three persons of one name in Hartford, two brothers and a cousin, were suddenly seized with a violent fever, of a putrid tendency, though in winter, and carried off within a few days of each other. At the same time, two or three others
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of the family were seized less violently in the same town, and recovered; and what is more singular, two other brothers, one in Litchfield, thirty miles from Hartford, and another in New York, 130 miles distant, were attacked nearly at the same time, and were very ill, but survived. No infection could have existed in most of these cases, as the persons did not see each other*.

Another instance occurred in Cambridge, Massachusetts, and is stated to me by the attending physician.

In October 1791, a young woman, belonging to a family in that town, but who had, for two years, lived at the distance of three miles from her father's house, was seized with a putrid bilious fever. Her mother repaired to the place and nursed her till she was convalescent. None of the family visited her while sick, except the father occasionally, and her eldest sister. The latter took the place of the mother, for a few days, who was called home to attend two other

* A curious fact is related to me by Dr. Dutton, of Oxford, in Derby. In the year 1795, almost every *male* child, born in the beginning of the year, in that and the adjacent towns, died within a fortnight by convulsions; but no female child was affected. This was observed to be more frequent in families that had been affected by the scarlatina, in the preceding year.

It will be remarked, that this was near the district of country which had suffered by a pestilential fever and dysentery.

children who were seized with the same disease, and who had never been exposed to infection. Before these recovered, three others were taken with the fever in the same family. The three last had doubtless assisted in nursing the sick, or been into their rooms, and therefore might have been infected.

In April following, another of the children, who had lived at a distance from the family, and had not been permitted to see any of the sick, was seized with the same fever at the house where she lived. In the same month, the father and another child were taken with it at home. Not one of the family, at home or abroad, escaped, except the mother, who had nursed all the sick, except one, and was most exposed to infection. The diseased were very offensive, but all recovered, except one; and neither my informant, the attendant physician, nor any nurse or visitor out of the family, was in the least injured by infection.

MS. letter from Dr. William Gamage.

This disease was a family pestilence, which began in autumn, was superseded by the cold of winter, and revived in spring. It resembles, on a small scale, the great plagues in London and Marseilles, and many others, in which a few cases occurred in the preceding autumn, clearly marking a pestilential state of air in that particular city; which

which state was arrested in its operation by cold in winter, but again exhibited its effects in spring.

The limitation of the disease to a particular family, of the same blood, or disposition to be affected by a certain morbid state of air, is a mysterious phenomenon, but the fact is so well ascertained, as to leave no room to question its existence. We can ascribe it only to a general state of air, fitted to produce injurious or fatal effects on bodies of a particular temperament, which temperament or disposition consists in the invisible structure or organization. It is demonstrated, that infection cannot be the only cause of the diseases in these families, and of course we are compelled to admit the existence of another cause, which can only be the atmosphere, for no other cause extends its operation to the distance at which the effects were produced.

It is on this principle alone that particular persons or families escape the worst plagues that have afflicted mankind, as related by Evagrius, and all authors on the subject, and of which we have numerous instances in America. But,

“ Why drew Marseilles’ good bishop purer breath,

“ When nature sicken’d, and each gale was death ?”

is the interrogatory of an inimitable poet, which has never been answered ; for on this subject, as

on every other, we are baffled and confounded, when we attempt to reach primary natural causes. The interior organization of animals and vegetables is far beyond the limits of human investigation.

Lord Verulam has left a passage confirmatory of the foregoing principles : "The plague, says this great observer of facts, is not easily received by those that continually attend the sick, as physicians ; nor again by old people, and such as are of a dry cold complexion.—On the other hand, the plague soonest seizes those that come out of fresh air, those that are fasting, and children. It is also noted to go in a blood, more than from stranger to stranger."

Works, vol. iii.

It is in analogy with the foregoing facts, that animals of different species are affected with epidemic diseases, which bear a similitude in their predominant symptoms, at different stages of a pestilential constitution of air. Sometimes horses, cattle, and sheep, feel the operation of the destructive principle, at the same time with man. At other times this principle will affect cattle a year before it reaches mankind. Sometimes it first affails the human race, and afterwards the irrational parts of creation. In some years one species of animals is affected ; the next year, another. Thus horses experienced the epidemic of
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of 1793, in the vicinity of Philadelphia, in the winter following the plague in that city. The fish in James river died in 1797; the cats perished in 1797; the oysters on the shores of Connecticut sickened in 1794; and the fowls in Connecticut in 1796.

Not unfrequently, the force of the pestilential principle, in one country, seems to expend itself principally on the brute creation; while in the same year, or succession of years, its principal operation, in a neighbouring country, is experienced by mankind. Thus in 1712 and 13, a very pestilential period, the cattle in Italy, Germany, and other places, received the full force of the pestilence in a desolating epidemic; while in Austria, Hungary, and the East, the pestilence fell on men. Thus also in 1770, while a dreadful plague was raging in Turkey and Poland, a mortal distemper swept away the cattle in Holland, Flanders, and some parts of England.

That the great general cause of the diseases among the different species of animals is the same, is obvious from this consideration, that during the same constitution of air, or pestilential period, the diseases of man and beast have a number of similar symptoms; such was the fact in Austria, Italy, and Germany, in 1712 and 13; and such has been the case in the United States.

In conformity with the general principle above mentioned, we observe that however analogous

may be the symptoms of diseases in man and beast, the distempers of one rarely infect the other. Infection is limited usually to that species of animals which have an aptness to receive the operation of the primary atmospheric cause of the disease. Thus diseased horses do not infect men, nor diseased men horses. So when a plague attacks the natives of a particular country only, the infection, like the primary cause of the disease, is restricted in its operation to those particular people. But this is rarely or never the case with the specific contagion of the small-pox and measles, in regard to mankind. Authors indeed relate, that hogs, dogs, and poultry, feeding on highly infected articles, or wallowing in the filth thrown from houses, during the plague, have died with a similar disease. A few instances are mentioned by Diemerbroeck, Boccace, and others. Hodges mentions a disease taken from a horse, which ceased without becoming epidemic.

But these isolated facts form no exception to the general rule; for such distempers never spread and become epidemic. They only prove my general doctrine, that the contagious quality of plague is not a specific principle, but a quality capable of every possible degree of force; that in its lower or more attenuated forms it affects few or no persons whatever, but it *may* be so concentrated or condensed, as to destroy life, not only in bodies of an aptitude to receive the poison,
but

but also in other species of animals which have no such aptitude. Hence, the poison generated in the clothes of the sick, when put into chests or packages, uncleansed, in hot weather, may be so concentrated or increased by fermentation, as to kill almost instantaneously the person who opens them. But an infectious disease thus produced will never spread far, without the aid of a state of air which is pestilential. On the other hand, from thousands of instances in books, and within the knowledge of Americans, who are annually, monthly, and weekly, receiving infection from the West Indies, we know that the infection soon disappears in a healthy constitution of air. It may be so virulent as to give disease to the persons who first approach it, but in these the disease is extinguished.

It should be further remarked, as a useful hint, that persons removing suddenly from fresh air to an infected place, are doubly exposed. The increase of the pestilential causes is usually gradual; therefore, persons who live within their operation are insensibly fitted, by the flexible texture of the system, to sustain their effects. But sudden changes are very dangerous. The body will hardly ever sustain great changes in the powers of excitement, when suddenly made. Hence the extreme danger of removing from fresh to infected air; and sometimes of removing from infected to fresh air. The sudden alteration in the stimu-

lus operating on the system, may be as fatal in one case as the other.

Another distinguishing circumstance in pestilential diseases, and one that decisively marks different grades of violence in the causes, is, the manner in which the disease invades neighbouring cities. It is always observed, that during the prevalence of the plague, it attacks cities or towns at some distance, in one year, leaving other towns in the intervals between them untouched; the next year perhaps, or the second year after, it invades those intermediate towns which had escaped. This is always the fact, and it has puzzled all authors who have related it; yet the fact has never been accounted for, as its causes have never been understood. Mead, who was not personally acquainted with this disease, and whose theory led him to explain all its phenomena by contagion, was greatly embarrassed with this fact. He instances the escape of Vicenza, in Italy, in 1575, when Verona and Padua, one on each side of Vicenza, were severely afflicted; and in the next year Vicenza was desolated, when Verona and Padua were exempt. He could not explain how the infection, which came from Trent, where the disease first appeared, should *pass over Vicenza* and reach a more distant city.

Erroneous theories are the source of innumerable mischiefs in science. The fact is a common one, and on a just view of the causes of pestilence,

lence, is very easily explained. And what is surprising, Procopius and Evagrius have recorded facts which afford a clue to the secret, although medical writers, from their days to the present time, have suffered them to pass without notice. Procopius mentions, that the pestilence which began in 542, spread over the earth, but "if it passed by a particular country, at first, or *slightly affected it*, it soon returned upon it with the same desolating rage which other places had experienced." Evagrius also remarks, that "some places were more slightly affected;" and in another passage he says, that "in some cities a few families were seized the first year, and the rest of the city the year following."

Here we have a clue to the mystery. The plague seizes first the cities and towns where the general or local causes are the most powerful. Thus, the plague of 1575, which puzzled Mead so much, commenced in Trent on the Adige, which all geographers agree is a most unhealthy place. It next attacked Verona and Padua for a similar reason, and afterwards Vicenza, the intermediate town. The general cause, in the elements, had been four or five years in operation, producing a fatal spotted fever in most parts of Europe, continually increasing in malignancy, until it arose to the plague, and its crisis must naturally be in places where it was most aided by local

local causes, or where the general cause first increased to its full force.

The slight pestilences mentioned by Procopius and Evagrius, were the *precursors* of the severe plagues to follow; precisely as in London and Marseilles a terrible plague was preceded, in a former year, with malignant fevers and a few cases of plague. All history affords a tissue of proof, that the plague is never an isolated disease, starting up suddenly from infection; but the *crisis of a series of violent diseases*. To this I challenge the partisans of specific contagion to name an exception.

In America, we are able to solve the phenomenon of the escape of places intervening between infected towns. We find, without an exception, that when two cities are infected with pestilence, and an intervening place is not, if that intervening town is to be attacked the following year, the precursors of the disease appear there during the pestilence in the towns on each side of it. Thus the late series of plagues *began* in New York in 1791, in Water and Front-streets, where the local causes were most powerful. At this time appeared sporadic cases of bilious fever, more malignant than usual, in various parts of the country, every where indicating the commencement of a pestilential state of air.

In 1792 these indications continued; and in
a few

a few cases appeared the scarlatina, a new evidence of the reigning constitution.

In 1793 the crisis arrived in Philadelphia with serious mortality; and the indications of pestilence appeared in great increase of mortality in many parts of the country. At the close of this year New Haven, which was to be next attacked, began to show the forerunners of the disease, in the scarlatina, and in an increase of mortality of about one-fifth. In the next summer, 1794, appeared the bilious plague. In the same season appeared the disease in Baltimore, distant from New Haven about 290 miles, while Philadelphia and New York, intervening cities, escaped. But let it be observed, that a number of cases of the disease occurred in Philadelphia; and New York, which was to be assailed in the next season, produced its precursors in about thirty cases of violent bilious fever, ending in the black vomit. Thus, while on the extremes New Haven and Baltimore were severely visited, the approaching pestilence was announced at New York by a pestilential atmosphere, of a less degree of malignity.

In 1795 appeared the epidemic in New York, and in Norfolk, Virginia; while Philadelphia and Baltimore, intermediate cities, escaped, although the heat and humidity of the season every where rendered the country unhealthy. In this year the pestilential principle shewed itself in New
London

London and Providence in distinctly marked cases of the bilious plague.

In 1796, scattering cases occurred in the northern parts of America. In Newbury Port pestilence prevailed, but preceded by an increase of mortality, its precursor. The same disease prevailed in Boston, New York, and Charleston, while intermediate towns escaped.

In 1797 it appeared in Providence, Philadelphia, Baltimore and Norfolk, while New York escaped an epidemic, but a few very malignant cases occurred, showing the existence of the general cause.

So far as I can discover, not a spot on the globe has ever been visited with pestilence without its precursors, sometimes one, two, or three years, but always for some months before its invasion.*

If we had Bills of Mortality for Vicenza, in the years from 1570 to 1576, or a history of the diseases in the town during that period, I pledge myself that we should find, that during the

* Thucydides relates, that the year of the plague at Athens was remarkably free from other diseases preceding, and that the plague fell suddenly on the citizens. This may seem an exception to my remark; but is not; for all the neighbouring people were collected into the city, which was besieged; a circumstance alone sufficient to account for the sudden attack of the disease.

plague in Verona and Padua, on each side, in 1575, some malignant disease prevailed in Vicenza, which greatly swelled the Bill of Mortality for that year, and which announced, with almost infallible certainty, the approach of the plague. Instead, therefore, of saying Vicenza escaped the pestilence the first year, when Verona and Padua were afflicted, we should say the pestilence had *commenced* in less malignant distempers, but its crisis in Vicenza was to be a year later. This is the whole mystery, and the uniformity of this series of facts, from the days of Procopius to this hour, renders it a matter of astonishment that medical and other scientific men should have overlooked this great law of epidemic pestilence.

Diemerbroeck remarks the fact, as well as Procopius or Evagrius, that pestilence does not invade all places at once, but now this place, now that; and thus, in a series of years, extending over the earth. See p. 50, of Diemerbroeck, and the foregoing history of the plagues in Justinian's reign. But no author seems to have observed the progression of a general pestilential principle, which, if it does not occasion plague in two contiguous towns the same year, occasions plague in one, and other malignant diseases in the other, which certainly indicate its approach.

To prove that infection has no concern in this last mentioned phenomenon, according to the theory

theory of Mead and others, it may be observed, that the invasion of the disease in cities is perfectly analogous to its invasion of a whole country. The disease rarely begins at one point, and spreads from that, like the radii from the centre of a circle, nor does it follow the nurses and attendants of the persons first seized. On the other hand, it starts up in various distant parts of the town, among people who have no intercourse with the infected. To this it may be alleged, the fevers of Philadelphia in 1793 and 7 are exceptions; but, on critical examination, I find they are not. That in New Haven may be an exception. Thus Evagrius relates, that at the beginning the plague seized particular families, sometimes only one or two, and the rest of the town escaped till the next year.

Baronius, from Gregory of Tours, has well described the first progress of the plague in 590, in the southern cities of France. He says the disease was introduced by a vessel from Spain; the first record I can find of supposed importation by water. But when introduced, it did not seize every house at one time, but left intervals.

"Nec statim hoc incendium luis per domos spargitur totas, sed interrupto certi temporis spatio ac velut in segetem flamma accensa, urbem totam morbi incendio conflagravit." vol. viii. 15.

The metaphor here employed will appear striking to those who have seen a field of stubble or the
woods

woods on fire in a windy day. The fact also corresponds exactly with what has been observed in London, Marseilles, and other places, that the disease at first starts up here and there, in remote situations; then subsides for weeks, perhaps, before it spreads and becomes popular.

Thus, in Nimeguen a few cases occurred in November; then there was an interval of suspension; in January more cases; and in March the disease began to assume the shape of an epidemic.

Diem. p. 6.

In London, says Hodges, two or three persons died, in one family, with symptoms of the plague in 1664. In the holidays occurred another case; but a hard frost suspended the action of the infection. The diseased were at first shut up and guarded; but to no purpose. An order was issued and enforced, that a red cross should be set on infected houses with these words inscribed, " Lord have mercy upon us."

In May and June the disease, to use the author's own words, " reigned doubtfully;" sometimes in one part and sometimes in another; and to use Hodges's quaint expression, " it kept up a running fight," alternately inspiring hope and fear. This description is less elegant than that of Baronius, but it expresses the same ideas of the first progress of the plague.

It is strange, however, that the writers should not have seen that their facts totally overthrow their own ideas of infection; it being impossible that the operation of infection should be thus suspended, and afterwards revived. Frost totally annihilates infection, although it does not destroy the atmospheric cause of diseases.

Similar, in all respects, was the commencement of the plague at Marseilles in 1720. At first a few persons died suddenly, then the disease disappeared, and the citizens supposed it to be ended. Repeated hopes and fears were revived by the alternate appearance and disappearance of the malady, for some weeks in May and June. Yet the author who has related these facts, made a book to prove its origin from Levant infection!—so absurd are men when they attempt to support preconceived systems!

In America, the pestilential fever has first made its appearance in a similar manner. It has everywhere been preceded by an increase of mortality, and in most places has appeared in the scattering, interrupted manner of the plagues before-mentioned. In Philadelphia in 1797, and still more in 1798, scattering cases occurred in June and July, several weeks before the arrival of the supposed fomites from the West Indies. The same fact occurred in New York in 1795; some cases appeared two weeks before the arrival of the Zephyr,

Zephyr, the supposed source of infection. In Providence occurred the same fact. It has been strenuously asserted, that the disease of 1797 was from infection brought into Providence in the schooner Betsey from the Mole. On authentic evidence, collected with great care by a respectable citizen of that town, I can affirm that there is not the least ground for the opinion; and what utterly disproves it is, that eight decided cases of the fever had occurred before her arrival.

The whole secret of these phenomena is, that infection has usually nothing to do with the *origin* of the disease, according to the decided opinion of the learned Diemerbroeck, who saw the progress of the disease in Holland, and found it impossible to ascribe it in many places to that cause.

The reason why persons are seized in remote and scattered situations, and after different intervals of time, is, that the malignant principle is *progressive*. In its state of increase, it first produces diseases of a less violent type, and especially all kinds of eruptive diseases and catarrhus affections, as influenza, measles, small-pox, every species of angina, petechial fever, and, lastly, plague. In winter, the same cause often occasions epidemic pleurisy, or peripneumony of a most mortal kind, and always bearing some likeness to the epidemics of summer and autumn.

In this progression or increase of the pestilential principle, those persons are first seized who have the least power of resisting its operation. This inability may proceed from various causes. It may be occasioned by the natural organization of the body, some bodies being naturally more susceptible of disease than others. This indisposition of bodies to repel the morbid action of air or other causes, is hidden from the eyes of man; but that it exists, we have proofs in every day's experience.

Other persons are pre-disposed to certain diseases by artificial means. Thus every excessive stimulus induces indirect debility, a fruitful cause of diseases. Hence the liability of robust people to all violent fevers.

Others may be exposed to pestilential diseases, from living in situations where the pestilential principle is assisted in its operation by the debilitating qualities of morbid exhalations. Hence the early appearance and furious ravages of the plague in the narrow streets of cities, and filthy apartments of poverty.

From these and other causes, it happens that some persons are seized with pestilence long before the bodies of others yield to the action of the destructive cause. This will rationally account for all the variety of phenomena which accompany this furious malady.

The

The same reasoning applies to the angina maligna, which is another form of pestilence. Fothergill relates, that this disease appeared in London in a few cases in 1739, and then disappeared for a period of two or three years. It did not become epidemic, though very infectious.

Works, p. 198.

To confirm this hypothesis, I may remark that the plague is less infectious on its first appearance. This is admitted by Ruffel, on the plague of Aleppo, p. 19, 300, 297, and 315. At the same time, it is agreed on all hands to be more mortal than in its later stages. If infection were the cause, the reverse would be true, and the disease would be more mortal in proportion to the extension and the accumulation of infectious matter. The first cases also would be equally infectious, within the reach of their effluvia.

Stenkus observes, that many persons lived in infected houses, where others were diseased, for three or four weeks, without any ill effects; but they afterwards sickened and died. This he ascribes to an increase of infection, and recommends, as the means of prevention, changes of clothes and liberal use of water in the apartments. The fact may be explained on this principle; or it may be, and most probably is, the effect of the slow operation of the morbid air in inducing debility on particular systems. But it goes to prove

that the infection of the disease is not specific contagion, but a vapour or acid, unfriendly to health, that is capable of every imaginable degree of force; flighter degrees of which require a long time to undermine the energies of life.

Another consideration, which decides against the origination of the plague from infection, is, that almost all other diseases, whether infectious or not, exhibit the phenomena just described. It is not the plague alone that appears this year in one town, and the next in a contiguous one; or this week in one family, and the next in another; or at the same moment in two families or towns, at some miles distance. The same phenomena characterize dysentery, measles, anginas, and other maladies which are infectious; and even intermittents, remittents, and some others which are not spread by infection.

Such was the manner in which the fatal dysentery of the period about the year 1751, leaping from place to place, in different years, ravaged Connecticut for three or four years. The same took place, with that disease, from 1773 to 1777. It was scattering from place to place during a series of years, and then almost totally disappeared for many years. Sometimes it spread over a whole town; at others, it was limited to a particular street. In some instances, it swept away a large part of a family; in other instances, families entirely escaped. The same has been its progress

gress during the last five or six years. In 1794 it ravaged Derby; in 1795 New Haven. In 1798 it invaded a particular street in the country, two miles from Stamford, was infectious and mortal, while the town generally escaped.

The scarlatina, from 1793 to 1796, exhibited the same facts. Its general progress was eastward, but it often passed by a town and first seized one beyond it.

The angina maligna, in 1735 and 6, was remarked for the same manner of appearance. It began in Kingston, in New Hampshire, but instead of a regular progress, step by step, it seized Boston, fifty miles distant, before it did Chester, only six miles distant; yet its general progress was westward, and hardly any place escaped. Both this disease and the scarlatina of the last period, resembled the plague in these other respects—they were most mortal at first; and they affected families with very different degrees of violence, slightly troubling some, and extinguishing the lives of all the children in others.

The invasion of the influenza exhibits similar facts. It seizes at first only here and there a person; afterwards it becomes general, as at Edinburgh in 1762. See *Essays and Obs.* Edin. vol. iii. At other times it has seized whole towns in a night; nor does it proceed from town to town, according to their order on a map. Yet its general course is in one direction.

I could produce a multitude of similar instances of pleurisy and common autumnal fevers not infectious, which appear one year in one part of the country, and another in another, without any visible cause for this variety. The instances related by Dr. Buel, of the town of Sheffield, are very distinguished. See my Collection on the Yellow Fever, p. 53 and 60. That town contains two large ponds, which make considerable marshes, that are sources of remittents. In 1794 remittents of unusual violence appeared within the miasmata arising from the south pond—in 1795 a similar fever raged in the vicinity of the north pond.

This appeared at first an unaccountable phenomenon; but afterwards, the fever about the south pond in 1794, was ascribed to the drawing off the water, and exposing great quantities of putrescible substances to the action of heat. But still the difficulty is not removed. The north pond is admitted to be the most usual and fruitful source of diseases; but these did not appear in any extent in 1794. The question then is, not why the diseases occurred in that year about the south pond, but why they did *not* appear about the north pond, the principal focus of sickness in other years, and about which they raged with melancholy effects in the two following years? No alteration is suggested to have been made in the circumstances of the north pond; yet in one year its
5 exhalations

exhalations were almost harmless, and in the next they spread desolation over the neighbourhood.

See Medical Repository, vol. i. p. 458.

In such cases, just reasoning leads us to suppose the general state of the air, or the local exhalations, or both, differ materially in the degrees of their force and activity in different years; but to human eyes the cause of this difference is not often visible.

Sometimes a severe epidemic will rage in one town, and a milder epidemic of a similar type in the vicinity. Thus Zimmerman observes, that he has known a violent diarrhea follow a suppressed perspiration in September, in one town, when the dysentery was epidemic in the neighbouring country. To what shall we impute this difference of diseases, within a few miles of each other, but to the different force of local causes? A general cause, as a hot season, may pre-dispose the body to a disease of a particular type, but this principle may be modified by innumerable circumstances on the surface of the earth.

In analogy with these facts, is the manner in which pestilential diseases invade different species of animals. In one place horses are seized; in another cows; in a third sheep. In one year cats fall victims to pestilence; and the next hens and geese; but infection has no concern in these phenomena; and we are to ascribe them to the

various force of the pestilential principle in different seasons and places.

The phenomenon now under consideration has not escaped the observations of other physicians in Europe. Stapfer, cited by Zimmerman on physic, relates that the village of Oberwyl, in the Canton of Berne, was attacked with a violent dysentery in 1749, while the neighbouring villages were free from the disease. In the next year Oberwyl was healthy, while the neighbouring villages were ravaged with the same disorder, though not separated from the other by any mountain or forest. I have occasion, says Zimmerman, to observe something like this almost every year.

The English editor remarks on these facts, that "the dysentery, like other contagious diseases, is spread by communication with the infected persons and clothes, and, *therefore*, it is not strange that one village should escape, if its inhabitants were careful to avoid communication with their infected neighbours."

Just so important are all the reasonings of the infection-sticklers! The remarks are commonplace, and do not reach the point of difficulty. The question is, to know why several villages escaped the disease in the year when infection was *near* them, and were seized the next year when no infection existed. The winter's cold totally extinguishes the infection of that disease; so that the learned editor is left without a resource. If
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any infection had survived the frost of winter, it must have been in the village first infected, and in that place common sense and observation would teach us to look for a revival of the disease the succeeding spring. But no; that village is in perfect health, and others, where there had been no fomites, are laid waste by its ravages. Such are the facts, and no theory of contagion is able to explain the cause of their existence, in regard to this or any other disease.

The dysentery also has, in some places, made the discrimination observed in the plague; seizing persons of a certain nation or blood, and not affecting others who are equally exposed. In an epidemic dysentery in Nimeguen, the French and Jews all escaped.

Van-Swieten, vol. xvi. p. 57.

There is a fact related by Hodges and Diemerbroeck, respecting the plague, which must not be omitted. Many persons who had breathed the pestilential air of London and Nimeguen, went into the country, where they had the benefit of good air. Here they lived in health a month or two, then sickened and died of the plague. This is attributed to the latent poison, which lies long inactive in the system, then operates to the destruction of life. This may be the cause; but is it not more natural to ascribe the fact to higher excitement from a pure air, on a debilitated system, inducing indirect debility? Or shall

shall we suppose that a pestilential atmosphere is most stimulant, and that a removal into pure air induces direct debility? Perhaps the following facts will throw some light on the subject.

In 1789 I left Hartford in October, when the influenza was spreading in that town, and was seized with the disease just after I arrived at Boston. A fortnight after I returned with two ladies who had lived in Boston. In a week after my arriving at Hartford, the town of Boston was attacked with the influenza, and the two ladies at Hartford were seized at the same time. The conclusion I draw from the fact, is, that the constitution of air producing the epidemic is some time in operation before its effects are visible, gradually inducing a disposition in the system to that disease; and as it is progressive, it requires about the same time to run through its course in one place as in another, and is not always interrupted by local causes.

But the most incontrovertible evidence that infection is not the primary controlling cause of the plague, arises from the manner in which that epidemic ceases.

If infection were the principle and specific cause of its propagation, it must rage for ever, or as long as any of the human race should survive to receive it; for the longer the disease exists, the more extensive must it be. This conclusion is inevitable; for if infection spreads the disease so rapidly, that one or two diseased persons diffuse

fuse it in a few weeks over a city, the same principle must, in a given time, extend it over the whole earth, unless its operation should be arrested by a superior cause. And as one diseased person is supposed to infect more than one healthy person, its progress will be accelerated in a duplicate, triplicate, and quadruplicate ratio to its distance from its source. Its velocity also must be increased, not only by numbers in a crowded city, but by an augmented virulence, until all the inhabitants should be destroyed. But all this is contrary to fact.

Most plagues are modified and regulated by the seasons; but the cessation of pestilence in different countries is in different seasons, and seems to depend on opposite principles. In Egypt, a warm country, never reached by what may be called *cold*, the plague begins in winter, as in December, January, or February, after the Nile has subsided within its banks, leaving extensive plains and numerous canals exposed to a hot sun; with a slimy surface and stagnant waters in abundance on the face of the country. During this period also blow the southerly and suffocating winds, hot and dusty, from sandy deserts, which may augment the causes of disease.

On the other hand, the disease ceases in June, when the Nile overflows its banks, spreading fresh water over the face of the country; at which time

time also begin to blow the cool refreshing Etesian breezes from the North or Mediterranean sea.

Hence it is obvious, that the existence of the disease depends on the general state of the atmosphere; for the inundation of the Nile certainly does not wash away the infection from the houses and clothes of the sick. On the other hand, the plague ceases when the infection is most general; and this is true in every instance.

It may be said, that the plague arises from putrid exhalations in Egypt; and the reason why it ceases on the rising of the Nile, is, that the expansion of fresh water over the country, and a pure northerly air, destroy these exhalations.

In this observation there is truth, and it would account for the origin and cessation of the plague, if it was an annual disease, regularly influenced, and entirely governed by the seasons. But here again we are overthrown; for in most years putrid exhalations, which always exist at a certain season, do *not* produce the disease. Thus we are driven to seek another cause which is *not* influenced by seasons; and to suppose its *co-operation* with hot winds and stagnant waters in the generation of the disease. This is most undubitably the fact.

Again, the plague in Syria, farther North, where some winter's cold is experienced, begins in spring, as in February or March, and ends in June
and

and July, during the most excessive heat of the summer. This is the fact from Aleppo to Jerusalem, and has been from the earliest records extant.

Here then different causes, extreme heat and drought, seem to control the rage of the plague. But does heat destroy infection? Never, unless by combustion. No degree of heat that is ever felt in the tropical regions, or in America, has ever mitigated the force of infection, but always has increased it. Now we know that the heat of Syria never exceeds in degree what is annually experienced in the West Indies and the United States, to the forty-second degree of latitude certainly, and probably to the forty-fourth. In one respect Syria differs from this country; the summers are longer than in the northern States of America, and the climate subject to drought. But it cannot be the duration of the heat which destroys the plague; for that disease ceases at the very beginning of summer. It abates in June, and rarely appears to any extent as late as August. Nor can we conceive why drought in Syria should put an end to the epidemic; for in most *other* countries it has not that effect. In Europe and America extreme drought has very often inflamed its violence.

In this instance, then, we find no cause for the cessation of the plague in the weather or seasons which we are able to comprehend. We know the

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uniformity of the fact; and all beyond this is conjecture. Infection can have no concern in the effect, unless on some principle hitherto unknown; cool weather generates it, and heat destroys it, contrary to facts in all other countries.

Certain it is, that the plague at Aleppo, Damascus, Said, Jerusalem, Latakia, and on all the Syrian coast, ceases in extreme hot weather, and when the infection is in its utmost extent and violence. In Italy, Constantinople, in all Europe, and the temperate latitudes of America, ordinary plagues yield to cold; that is, they cease as epidemics of that form; but the general cause never fails to shew its influence in giving to the disorders of winter some of the general symptoms which characterize the epidemic of the summer. This proves,* that in common pestilence, morbid exhalations *aid* the atmospheric cause in producing the epidemic; and that it is not specific contagion which contributes to spread the disease; for this is not influenced by cold, but it is morbid exhalations that yield to cold. Hence, in northern climates, cold suspends the action of the two subordinate causes of pestilence, morbid exhalations and infection; and this is usually sufficient to check the epidemic.

But that the great primary cause is not affected, or rather subdued by cold, is apparent from these facts; that, although the plague, in its peculiar autumnal form, is suspended, yet the
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diseases of winter, as pleurisy and peripneumony, wear the same livery, which can be occasioned only by the continued action of the same cause. Further, some plagues have not yielded to cold, as I have before observed. Several instances have occurred in which the disease has run through all the seasons without interruption or abatement. This fact demonstrates, that the primary cause existing in the essential properties of the elements, may be of various degrees of force, and does at times actually arise to a degree capable of producing and continuing that disorder, not only without the aid of morbid exhalations and infection, but in defiance of cold.

In conformity with this idea, is the fact that a pestilence which begins the earliest in the season, is the most mortal. This is agreed by P. Alpinus, Van Swieten and Sydenham. "*Minus sæva est, quo tardius illuc accessit, viderique incipit; ita ut quo tardius venerit, eo mitior ac brevior sit judicanda,*" says Alpinus, *Rerum Egypt.* vol. iii. 70. The reason of which is, that in proportion to the strength of the elemental cause, it begins to exhibit its effects early in the season; that is, with the *least aid* from heat, noxious effluvia, or other local causes. If the general contagion of the atmosphere is very powerful, its effects may appear even in winter in opposition to cold. Hence the justness of Diemerbroeck's remark, that pestilence beginning in winter is the most

most fatal. If, on the contrary, the general constitution of the air is less hostile to life and health, it will not produce an epidemic pestilence till it is assisted by great heat and local vitiation of the air; therefore the disease will not appear till late in the season.

Something like this, on a small scale, has characterized the different epidemics in Philadelphia. In 1793 the precursors of the epidemic were light, and the first cases did not appear till the last of July, or beginning of August. In 1797 and 98 the first cases occurred in June, and the disease in the latter year was marked with by far the most malignant symptoms, although the timely evacuation of the city prevented Bills of Mortality equal to that of 1793.

In New York this circumstance, it is believed, has been less noticeable; but it may be remarked, that in the years of the epidemic the first cases occurred in the last week in July, and in years when a few sporadic cases * only have

* The advocates of the specific contagion of the plague do not admit that the true plague ever appears in sporadic cases. They think, if it once appears, its contagion must of necessity spread it. This is all a whim. I believe, with Dr. Mitchel, that any disease, of the worst type, may be generated in the body solely by a derangement of the functions of the stomach and intestines, and the poisonous air extricated from food. But that sporadic cases of plague may occur, and do occur very often, I have not the least doubt.

During

have appeared, they have not occurred till many weeks later. Besides, it is very obvious that the diseases of 1795 and 6, if not 1797, were powerfully influenced in their commencement by local causes, as great masses of putrid matter in the parts of the city where the first cases occurred, and where the epidemic exhausted its principal force.

In general, it may be observed in our climate, that if a malignant fever does not appear in a city till late in August, the citizens need not apprehend very general desolation. If cases occur early, as in June, there is serious ground for apprehensions of danger. The only exception to these remarks, is, when the seasons suffer some great, unusual, and sudden vicissitudes, which during a pestilential period may overwhelm a city with almost instantaneous calamity. Such may be a sudden invasion of heat in August after preceding cool weather.

In general it is a just remark, that as the force of the pestilential principle is of various degrees in different periods, so when it is most

During the late war in 1776 or 1777, two brothers, by the name of —, arrived from the army at Greenwich in Connecticut; one had a malignant fever with glandular tumours; the other was his nurse, and in good health. The sick man died soon after he arrived, and in less than twenty-four hours his brother was also in his grave. This was true plague; but no other attendant was infected.

powerful it attacks men the earliest in the proper season, and is destined to be most destructive.

The preceding facts and conclusions seem sufficient to establish the great point, that neither contagion nor infection has ever had much influence in originating or propagating pestilential epidemic diseases of the autumnal kind.

But objections remain to be answered. It is alleged that the plague begins in maritime places, and thence spreads into the country adjacent. Thus is it asserted by the College of Physicians in Philadelphia, that the pestilential fever in America "commences invariably in our sea ports, while inland towns, equally exposed to the ordinary causes of fever, escape."

Memorial, dated Dec. 5, 1797.

Pliny, a great observer of facts in the natural world, goes farther, and asserts, "that pestilence is observed always to proceed from southern regions towards the setting sun; nor does it scarcely ever happen otherwise, except in winter."

Lib. vii. Cap. 50.

Mead, and the author of *Traité de la peste*, have cited this opinion with approbation. By the words of Pliny, "*a meridionis partibus ad occasum solis*," must mean from Egypt and the Barbary coast, towards Italy, Gaul, and the other western parts of Europe.

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From these facts is inferred a strong argument in favour of the propagation of that disease by contagion.

With deference to these great authorities, not one of these assertions is accurate. That the plague generally appears first in sea ports, is a just remark; and, according to the laws of nature, it must be so without infection. But to this rule there are many exceptions. The general plague, in the days of Thucydides, originated in Ethiopia near the borders of Upper Egypt, *not a sea port*.

The violent plague in 252 began in the same region; as did that of 1736.

The plague of 542 began in Lower Egypt, between Pelusium and a morass called the Serbonian bog, at a distance from the port of Pelusium. It should have been mentioned, that the mortal plague in the reign of the Antonines began in Selucia, on the Tigris, far from the sea. The black pestilence of 1348 originated in China. That in 1450 in some part of Asia. The pestilence of 1348 began, when it first appeared in France, in Avignon, *not a sea port*; as did that of 1482. The plague of 1575, in Italy, began at the northward in Trent, and proceeded southward, contrary to the assertion of Pliny; and every one knows Trent is not a maritime place. The plague in Holland, in 1663, began in Heusden, *not a sea port*, but on a river, and near a

a morass. In 1702 a plague broke out in Poland, far from the sea.

With respect to the United States, the assertion of the College of Physicians must stand or fall, according to the definition of the fevers which have appeared in the country. If no pestilence has ever appeared, except in sea-ports, we must affix some other name to the mortal epidemics that visit the interior of our country. Certain it is, contrary to the statement of the College of Physicians, that the true yellow fever, and so called at the time, prevailed in Albany in 1746, and probably no where else in the northern states, though a sickly year.

About the marshes in the interior of our country, an epidemic bilious fever has, times without number, raged as fatally as ever it did in Philadelphia, destroying life in three or four days, attended with all the characteristic symptoms of yellow fever, and carrying off almost every person within the region of its atmosphere. This has happened about some of the lakes in the State of New York every year since the present pestilential period commenced, and whole villages have been depopulated. If the College of Physicians choose not to call this disease yellow fever, I cannot help it; but sure I am, if it is not that specific disorder, it is one equally desolating, and as little entitled to be fathered on the country as any species of plague whatever. It is a fact also, that
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the bodies of those who perish by that fever, near rivers and lakes, are, if possible, more yellow than in cities.

But what utterly disproves the assertion of the College of Physicians, is, that the same pestilential distemper which has lately afflicted our cities, appeared among the aborigines of this country before it was settled by the English, before the West Indies were settled by the English or French, and before a single vessel from the islands had ever reached our shores. To confirm this fact, it is well known that the same disease has often visited them, since the English settlement, and in situations and under circumstances when it was not possible for them to receive it from infection, as at Nantucket and Martha's Vineyard in 1763, and several times in the limits of the present State of Rhode Island. The Onandagoes in the State of New York, three or four hundred miles from a sea-port, about eighty years ago were attacked with pestilence, which wasted the tribe; and the place where the village was then built, has, on the account of that mortality, been ever since abandoned, and is now over-grown with trees.

What the disease was I am not informed; it might have been the small-pox; but the country where it happened is now subject to mortal bilious epidemics, which kill in three days, and turn the body as yellow as saffron. Besides, the great plague in 1618 is known to have been the

true infectious yellow fever, and so was the fever of Nantucket in 1763, neither of which could possibly have been imported.

About sixty years ago a great mortality happened among the Indians on the north-east of a small stream, a little south of East Greenwich, in the State of Rhode Island. The disease was fatal to almost all who were affected; but it was local and infectious; for a law was passed that no person should go from one side of the river to the other, and the Indians on the opposite side remained in health. This place was no sea-port, but an Indian hamlet; and no pretence of importation is suggested, nor does it appear that any whites were affected.

About twenty-six years ago a malignant bilious fever attacked the Indians at Quidness Neck, in North Kingston, in the same State; and most who were seized perished. It attacked also a few families of whites, but with less mortality. North Kingston is a sea-port; but there is no suggestion of foreign origin.

MS. of Moses Brown, of Providence.

From these facts let the public judge how little reliance can be placed on general assertions, even of learned and respectable societies, when made without a critical examination of the subject.

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It is proper that I should here take notice of an assertion found in a number of authors, "That Thucydides relates the plague in his days to have spread from Ethiopia by means of contagion, infection, or fomites." The learned Diemerbroeck has fallen into this mistake. p. 48.

Galen is more correct, when he says that pestilence spread by the corruption or infection of the air. This idea, though not the expression, is accurate.

The truth is, Thucydides does not say that the distemper spread by infection or contagion. The literal translation from the Greek is as follows: "It began, as it is reported, first from Ethiopia, above Egypt; then it fell on Egypt and Lybia, and a great part of the king's dominions (Persia). It then suddenly invaded the city of Athens, and first the Piæroeus." In the paragraph preceding, he says, the disease had prevailed in many regions, first and especially at Lemnos, but does not hint at infection or contagion as the cause.

The observation of Pliny, that pestilence originates in southern climates, and proceeds northward and westward, is generally, but not always true. Alexander Ruffel tells us, the pestilence in Aleppo, in 1719, came from the northward; and many authors relate that it appears in Constantinople or Smyrna before it does in Egypt. This may be partly owing to alterations in the Turkish cities since Pliny's time.

But on just principles the fact is rationally explained. If a particular state of air, favourable to the propagation of that distemper, must exist before it can become epidemic, which is admitted by the friends and foes of contagion, then supposing this *general* pestilential principle to exist at a given time, in equal force, all over the earth, or any portion of it, it must follow inevitably that this general cause will produce the worst diseases *first* in climates and situations where the most powerful *local* causes exist, as heat, moisture, and all kinds of deleterious exhalations. And for a more obvious reason, the debility of the human body must be first induced in those situations.

This is a complete solution of the fact mentioned by Pliny; and he himself justifies the explanation of it; for he excepts from his own general rule the pestilence that appears in winter; a circumstance passed over by Mead. Now the reason why a plague beginning in winter does not follow the course of one beginning in summer, but appears sometimes in northern climates *first*, is, that such a pestilence does not require the aid of contingent causes, as noxious exhalations. It is independent of *local causes*, and induced solely by the essential qualities of the air; it may therefore appear first in any place or climate whatever, according to the state of the air. This happens only in great plagues, which seldom occur.

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These observations apply also to the objection that pestilence first appears in maritime places, as mentioned by Procopius and others.

It is a fact known to every medical man, that humidity is a cause of debility. Hear what the learned Zimmerman says on this point :

On Physic, vol. ii. p. 100.

“ The humidity of air weakens a man suddenly; it relaxes the solids, and of course weakens the circulation, so that the secretions are carried on with difficulty. The insensible perspiration is checked, the moisture passes in through the absorbing pores of the skin, and the patient feels a lassitude and heaviness which deprive him of all his gaiety, and render the mind as oppressed as the body.”—“ Damp situations are, in every country, unhealthy.”

p. 102.

There is not a person living who cannot testify to the truth of these remarks. Hence the languor which depresses a man in a hot, sultry day, with a southerly, light air, *loaded with vapour*. Hence this state of the air, when of long continuance, never fails to generate epidemic diseases; and if it occurs during a pestilential constitution, mankind seldom escape the ravages of the plague.

It may be said that the inhabitants of maritime towns are less exposed to this source of debility than

than seamen, who are in general remarkably healthy. To which I answer, that the ordinary moisture from sea-air never of itself produces diseases; and at sea there exists no exciting cause, as morbid exhalations, unless in ships of war and crowded transports, in which diseases often proceed from human effluvia. But I question whether the bodies of seamen possess the same firm texture as those of labouring farmers in the country. Certain it is, that seamen in general are not so long-lived men as farmers. This is ascribed to their irregular and severe fatigue; but I suspect it more owing to the incessant operation of the debilitating powers of moisture.

Whatever may be in this, it is certain that moisture of *itself* induces debility, in a greater or less degree, though not disease; but when its action on the system is combined with the operation of morbid exhalations, which abound in cities, especially near navigable water, together with the frequent alternations of heat and cold, occasioned by the contiguity of land and water, we are not to be surprised that cities on the borders of the ocean, and the banks of rivers, are the first to be attacked with pestilence. We might, without the aid of facts, prove *a priori* that this must generally be the case.

Hodges mentions that the London plague of 1665 spread into the adjacent country, *especially along the Thames*; but he takes care to ascribe

this to infected goods, and not to humidity—
another proof of the mischiefs of theory.

Indeed the circumstance that, next to large maritime cities, the towns situated on the borders of rivers or lakes are the most severely harassed with epidemics of a fatal kind, especially autumnal diseases, is an evidence of the truth of the same principle. Wherever we turn our eyes, we see autumnal diseases, from simple tertians to the plague, most frequent and most deadly in low situations, under the combined operation of heat, moisture, and different species of noxious exhalations. It is therefore as unphilosophical to deduce, from this fact, arguments in favour of the foreign origin of the plague, as in favour of the importation of many other malignant diseases; for the same phenomena attend them all—they all appear *first*, and are most epidemic and fatal, in the vicinity of water. This is their general rule, to which exist some exceptions, as well in regard to the plague as to other bilious complaints.

But the discovery of a general pestilential principle, extending over a whole hemisphere, or the whole globe, nearly at the same time, or with a rapid progression, solves all the difficulties on this subject. Had Pliny known that, at the moment a severe plague appears in Egypt the diseases of all Europe, or all the world, assume unusual malignancy, or other contagious and infectious epidemics appear in every quarter, to the distance
of

of a thousand leagues, his remark would have been equally just, as to the origin and progress of the plague, but it would have opened to him new causes of its origin, and a more just and philosophical view of the phenomenon. This is a discovery which prostrates all theories of specific *contagion*, and reduces the influence of *infection* to its just measure.

Another fact. Forestus has declared, that in pestilence three times the number died in wet weather as in fair and dry weather; the infection being less easily dispersed in wet weather, which is evident from the smoke of chimnies.

Van Swieten, Vol. xvi. p. 26.

It is well known in America, that while the weather is hot, rains and moist air greatly multiply cases of pestilential fever.

In 1720 a storm of thunder and lightning at Marseilles, late in July, was followed by a great increase of the plague.

Traité de la peste.

Every one knows that the air along the borders of the ocean corrodes iron and other metallic substances. Is it not then questionable whether the saline acid, which impregnates the maritime air, has not some deleterious effect on the human body, when combined with other vapours from the earth? Are we yet acquainted with the essen-

tial properties of all the possible combinations of aërial substances?

Again; Mead has remarked, that countries and cities which have had most commerce with Africa, as Marseilles, have been most frequently afflicted with the plague. A French author, he says, reckons twenty plagues that have infected Marseilles, notwithstanding its healthy situation.

In opposition to this, it may be proved by facts, that the cities in the interior of Germany, that never had any trade or communication with Egypt, used formerly to be harassed with that disease, nearly, if not quite so often, as the maritime ports of England, France, Spain, or Italy. Any man will learn this who reads the whole history of that calamity, instead of that of a few detached instances.

As to the twenty plagues of Marseilles, ascribed to the trade with Egypt, I would observe, that I can produce the history of nearly double that number of violent plagues in London, *before* that city had any trade or connection with Egypt.

Equally ill founded is the idea of medical writers, that the yellow fever of the West Indies was brought first from Siam. "Maladie de Siam" is the name given to it by French physicians, and this improper name will serve to perpetuate the error, while it shall exist as a monument of
ignorance

ignorance and false philosophy. This pretended Siam fever was the pestilence of the Indians on this continent, before the West India Islands were settled by the French.

Another extraordinary assertion of Mead is, that "the northern nations of Europe, before their connection with Africa in trade, grew populous more rapidly than in modern times."

I will not contest the assertion, as it regards the degree of population of those countries in different periods. Authors differ in opinion on the subject of the ancient population of Europe, and no certain documents or facts exist by which the point can be ascertained.

But the implication necessarily deduced from Mead's assertion, is, that the plague is more frequent and destructive in the north of Europe since a trade has been opened with Egypt than before; for on this principle only would he account for the reduced population of modern times. If this is what he meant to insinuate, the assertion is not simply inaccurate, but absolutely false. From the first accounts we have of Russia, Poland, and the Baltic regions, to the first opening of a trade with Egypt in modern days, plagues were much more frequent and fatal in those countries, than they have been within the last century, since a constant trade has been carried on with Egypt and every part of the Levant.—For the truth of this assertion I appeal to facts.

In

In the year 1485 the English first opened a trade to the Mediterranean, especially with Italy, and a consul was appointed, resident at Pisa. The act of appointment by Richard III. contains this passage; "Whereas certain merchants and others from England, *intend* to frequent foreign parts, and chiefly Italy, with their ships and merchandize."—Before this England had little or no trade *directly* with foreign countries. All her trade was conducted by Lombards, Genoese, Venetians, and the Hans merchants. There was no direct trade to Egypt and the Levant.

About the year 1511, English ships began to frequent Sicily, Candia, Chios, and the Syrian coast; but this was accounted a very hazardous voyage, and ships seldom made it in less than a year.

In 1535 English factors first settled in those countries.

See Anderson's Commerce, vol. i. p. 683. vol. ii. p. 79. Rymer's Federa, vol. xii. p. 261. and Hackluit's Voyages, vol. ii. p. 96.

Now the fact is, that the plague was as frequent and severe in England, Denmark, Sweden, and Germany, in the tenth, eleventh, twelfth, and thirteenth centuries, before any foreign trade existed, as in any later period. Not to mention the universal plague in the days of Vortigern, about 448, which never has been exceeded in extent

extent and violence, unless by the black pestilence of 1348.

The Levant company was first established by Queen Elizabeth in 1581, and the act of incorporation expressly states, that Sir Edward Osborn and his associates, the persons incorporated, had, at their own great costs and charges, *found out and opened* a trade to Turkey. Before that time, the commodities of Egypt, Syria, and Turkey, were all imported from Italy in Venetian or Genoese ships.

The commerce of the north of Europe, from the year 1200 to 1500, was almost wholly in the hands of the Heanfeatic Confederacy; but, on careful investigation, I cannot find the least trace of a direct trade to the Levant by the towns in that league. Indeed before the discovery of the mariners' compass in the fourteenth century, all trade was carried on by coasting. History records more than one hundred general plagues before that discovery. So totally false is the assertion of Mead.

But, say the College of Physicians in the memorial before cited, "Proper health laws, strictly enforced, have latterly protected the commercial parts of Europe from its ravages."—This is a point of importance, and while the assertion stands unsupported by proof, I am at liberty to deny the truth of it, and there leave the question, as fair on one side as the other; for I cannot prove
a nega-

a negative.—If, however, the laws of quarantine have produced the effect alleged, it is very strange that the plague did not disappear at a much earlier period.

The institution of health laws was as early as 1484, and it appears they were first introduced at Venice. If these laws have ever prevented an epidemic plague, it is very strange that they were ineffectual in Venice, and other parts of Italy, for near two hundred years, as they certainly were. It is indeed wonderful that, during the sixteenth century, when all Europe was almost continually ravaged by that disease, and down to the close of the last century, no man could be found to devise a law, and no police to enforce it, so as to arrest the progress of the plague in Italy. Yet such was the fact.

The first statute I believe in England to restrain the progress of infection, was in 1604, in the first session of James I. 31. The regulations attempted by the proclamation of Queen Elizabeth in 1580, before recited, prohibiting the enlargement of London, and the residence of more families than one in the same house, could not, from the tenor of them, be carried into effect. The statute of James limits its provisions to the confinement of the sick to their houses, a breach of which was made felony. An enforcement was attempted in the subsequent plagues, and especially in 1665, but without the least good effect,

as to the city at large, and with a very ill effect upon the diseased and their families. It is certain, however, that a strict execution of such a law, would arrest the progress of *infection*; for the infection of the plague is found, and admitted on all hands, to be confined to contact, or very near approach, so as to be received by the breath of the diseased. If, therefore, the disease was propagated by infection only, such confinement of the sick would check its progress, if not annihilate it. We know by repeated experience in America, that there is not the least difficulty in putting an end to a disease of specific contagion; and it has often been done in cases of the small-pox. Hence, the inefficacy of the law of James I. after repeated trials in the plague, is a strong evidence that its propagation depends on some other cause than infection.

From 1604, to the reign of Queen Anne, no general laws were enacted on this subject, as far as I can discover from the printed statutes. In the ninth year of Queen Anne, 1709, passed the first statute enjoining vessels to perform quarantine; at least I can find none earlier. This was repealed by 26th George II. 1752, a new statute on the subject, which was afterwards amended by the 29th of the same reign.—Now it so happens, that the plague ceased in London in 1666, forty-three years *before* a general quarantine was instituted. Particular laws had been passed before,
on

on emergencies, as in 1664, when all importation of goods from Holland was prohibited, on account of the plague then in Holland, but without effect. The truth then is, so far as regards Great Britain, now the most commercial country on earth, and at the time in question, the most commercial, next to Holland, the plague entirely ceased and disappeared, forty-three years before the existence of quarantine laws. If any mistake occurs in this statement, it must proceed from want of materials—my enquiries are limited to Blackstone, and the printed statutes at large, the only documents I possess on that subject.

In the course of my reading, I have found but two or three instances, in which it has even been *supposed* that health laws have preserved a city from pestilence. Mead mentions two instances; one at Ferrara, in 1630, when every person, seized with the disorder, was immediately removed to a lazaretto, which being done in seven or eight instances, the disease was checked and disappeared.

Another instance he mentions was at Rome, in 1657, where the persons first seized were removed to lazarettos, and their families to hospitals, without the city, and the city was soon freed from the disorder. He supposes further, that the disease was suspended a whole fortnight in Marseilles, in 1720, by the same means.

I have no account before me of the origin and progress of the plague in Italy, in 1630 and 1657, except the sketches found in Mead's works; but wherever I can obtain a correct account of this disease, mentioned also by Mead, I find his statements are imperfect and erroneous; I therefore place very little dependance on them. That the plague in Marseilles was stopped a fortnight by regulations of policy, is not true. The disease appeared in the preceding autumn, and was suspended five or six months by the winter. When it appeared in the month of May, 1720, writers say the first cases were among those who had intercourse with the ship and goods from Said; but all those goods were prohibited to be carried into the city, and subjected to fifteen days retreat and purification. The porters who had concern with them were confined. Some weeks after, in the month of June, cases of the disease appeared in the city; all precautions had proved useless; as the hot weather came on, the disease started up here and there in the city, among persons who never had any concern with the ship or the goods, or the infected; it then subsided, then again appeared, in the manner before related.

Whether the persons seized in May contracted the disease from the goods, or foul air of the ship, or not, is not material; for the goods were cleansed, and all the diseased confined to the hospital, and all the porters shut out from the city.

city. Yet when the disease appeared in the city, no person could tell how it came there; many were seized who had never been near infection; and hence the populace resort to supposition to account for its origin. They *suppose* the disease had come from the goods after they were cleansed, though they had no evidence of it. Besides, I have before remarked under the year 1720, that the goods could not be infected, for it is admitted on all hands, that they were shipped at Said, when the disease was *not* in that port.—The ship's hold might have generated foul air on her passage, and the first person connected with her might have contracted a pestilence from that air, which is not an uncommon thing in such a very sickly period as that was, when mortality was increased all over Europe and America. But the truth is, had that air been the cause of the plague in the city, the disease would not have been suspended for six weeks, but would have made a regular progress from one patient to another. But no; it disappears for six weeks, and then breaks out in parts of the city remote from the supposed source of infection, and among people who had not been near that source: So inaccurate and inconsistent appear all accounts of the contraction of epidemic diseases from fomites, which I have been able to investigate by full and authentic documents. This shows how little reliance we can place on partial statements, made

to support favourite systems.—I therefore am persuaded that the cases mentioned by Mead of the effectual restraint of the plague in Italy, by removing the sick, are not fully stated, or that an accurate inquiry would prove the supposed effect to result from other causes.

The following facts will furnish a more rational solution of the phenomenon.

In the United States, ever since the commencement of the present constitution of air, that is, from 1790, sporadic cases of our pestilential fever have occurred, not only in cities, but in various parts of the country, more or less, every summer and autumn. In 1792, occurred a number in New York; also in 1794, when one case exhibited infection; and in 1797. Of about thirty cases perhaps, in each year, some of them were excessively violent, highly marked, and in a degree infectious. In 1791, and in 1796, several hundred cases appeared, yet the disease was not epidemic, but local; and the business of the city was not suspended. Now had every person, the moment of his seizure, been conveyed out of the city to a hospital, the escape of the city in each of these years, would vulgarly have been ascribed to that circumstance. This was doubtless the case in Ferrara and Rome, and this is unquestionably the solution of the fact, that the cases in the Italian cities were sporadic cases, which always occur in the neighbourhood of the plague. This
disease,

disease, in the years mentioned, raged in other parts of Italy; the cases mentioned by Mead were sporadic cases, indicating a pestilential constitution of air extending to those cities, but of a less malignancy, and too mild to produce a general pestilence in those places; it infected only a few persons of habits most susceptible of it; and to these it probably would have been limited, had none of them been removed.

A similar fact occurred in Philadelphia in 1794. Eighty or a hundred persons died that year of the true yellow fever; none of them were removed; but to these was limited the operation of the pestilential principles, local and general; and no epidemic ensued.

In New-London a case occurred in 1795; and in 1796 several cases of the same disease; but no epidemic, although no removal of the sick took place.

In Providence sporadic cases have occurred almost every year with decided symptoms of the infectious yellow fever. In 1791, in June, died two daughters of a widow in the centre of the town. They vomited bilious matter, and their bodies were yellow with livid and purple spots. Other cases occurred the same year; one case in 1792, and a number in 1793, 4 and 5; cases which could not possibly have originated from foreign sources. Some of them appeared to be infectious, as that of the young women first men-

tioned, the first being taken on the 4th of June, and dying on the 7th; the second being seized on the 9th, and dying on the 12th. Yet no epidemic followed; and had these patients been removed to a distant hospital, the safety of the town would have been ascribed to that removal; and the salutary effects of health laws, would, by Mead's followers, have been trumpeted over the country; and what is worse, would have been recorded as an important fact, which would hereafter mislead posterity.

Nothing is more dangerous than to build a theory, or to establish a general principle on a few detached facts inaccurately stated, and ill-understood.

With regard to the case of Rome stated by Mead, it must be observed, that the disease had, in the preceding year, killed 10,000 of its inhabitants; and in the kingdom of Naples 400,000. The disease had probably finished its course in that region; and the few cases in Rome in 1657 were only detached instances, the remains of the pestilential cause, such as occurred in London in 1666, after the fatal plague of the preceding year. It is by no means probable that the disease, if neglected, would have become epidemic.

But we have stronger ground to oppose the idea of the College of Physicians, relative to the effect of health laws. Numerous examples are on record, in which the full force of the best

regulations to prevent pestilence has been applied in vain; and since the publication of the College, from which this idea is taken, Philadelphia has witnessed the futility of such regulations.

In 1636, the law to prevent infection was rigorously executed in London; the sick were confined; suspected families were sequestered; but all to no purpose; the disease spread; the legal restrictions were then taken off, and no ill-effect followed; the distemper spread no faster than before.

In 1665 the same regulations were tried in vain; and so was the law, prohibiting the importation of goods from Holland.

The approach of pestilence towards Dantzick in 1708, in which year it appeared at Thorn, alarmed the magistrates of the former city, and every possible precaution was used to prevent its reaching Dantzick. Commerce and communication with infected and suspected places were forbidden; no sorts of merchandize, especially those which are most apt to retain infection, were permitted to enter the city from such infected places; all strangers and travellers were strictly examined, and none suffered to enter the city without sufficient proof of coming from healthy places; all the inhabitants were cautioned not to hold correspondence with infected places, nor to harbour those who came from them.

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These and other regulations were enjoined by an edict in July 1708. Yet all to no purpose; the plague appeared at Dantzick the next spring.

Baddam's Memoirs, vol. vi. p. 6.

This is a remarkable instance of the futility of human regulations when opposed to the laws of the physical world. The people of Dantzick, had they been acquainted with the principles of pestilence, might have foreseen in 1708 the probability of the inefficacy of their regulations. The state of the air in the production of millions of spiders, and the increasing mortality in the city, indicated the existence of a state of the air unfriendly to health, which was increasing, and only required a little more virulence to generate the evil, which they ignorantly supposed must come in sick bodies, goods or old clothes; and which they were idly combating on that mistaken principle.

It has already been stated, that the rigorous execution of health laws at Marseilles in 1720 proved utterly fruitless.

The plague which desolated Naples in 1656, was said to be introduced into that city by soldiers from Sardinia, where it raged the preceding year. Yet the Viceroy, Count Castullo, had prohibited all intercourse with Sardinia. After the disease appeared, which was first in the form of a malignant fever without glandular tumours, all possible

possible means were used to prevent its spreading, but to no purpose.

The confidence in modern health laws is like the respect which the ancient Egyptians paid to the bird Ibis, which they supposed averted the plague by destroying the flying serpents that the hot Lybian winds brought into the country.

Cicero, de Nat. Deor. lib. i. 36.

The Egyptians were like all modern nations; unwilling to believe the plague generated at home, they ascribed it to infection brought by flying serpents, as the moderns ascribed it to old clothes, bales of goods, and infected ships. They mistook the cause, adored Ibis as the moderns do quarantine, and with the same ill-success.

But we need not step off of our own territories to find evidence of the inefficacy of health laws, when opposed to the operation of the laws of nature. No expedient has been left untried to ward off the calamity of pestilence, but without any visible effect. The severity of the affliction in Philadelphia in former years, had rendered the magistracy of the city extremely careful to guard against importation in 1798. The most rigid quarantine was exacted—ventilators of the best construction employed—the vessels were washed, fumigated, white-washed with lime, and every practicable mode of purification adopted. Not
a vessel

a vessel was suffered to approach the city without satisfactory evidence of the healthy state of the people, and the salubrity of the vessel and cargo.

See the letter from Hillary Baker, Esq. Mayor of the City, to the Mayor of Baltimore, dated August 13, 1798.

Alas! all to no purpose! The ravages of the disease are well known.

If, says the late worthy Mayor, the disease has eluded the health officers, I shall despair of future success, unless the West India commerce shall be prohibited during the summer months, and magazines established below for receiving the cargoes.

Similar provisions in other ports have been established with no better success. The health laws of New York, so far as appears, were as well executed in 1795, 96 and 98, when the fever was epidemic, as in 1794 and 7, when it was not. No visible good effects are to be discovered in guarding against an epidemic; the utility of cleansing vessels therefore is limited to guarding against the operation of infection upon a few persons who may enter them with foul air on board. Public health, so far as can be discovered, has never been secured by those regulations. What seems to place this point beyond question, is, that for thirty years preceding 1792, no pestilential fever ever spread in America, from the 10,000 infected seamen and passengers which arrived in the country

try from the West Indies, and during which time, in most places, not the least precaution was ever used to guard against it; yet since 1792, that is, under a state of air generating various epidemics, the pestilential fever has appeared in sporadic cases every year, and in almost every town in America; and has raged as an epidemic in most of our large towns in opposition to the utmost efforts of human skill. I am persuaded, the conclusions from these facts amount to a demonstrative evidence, that infection is *not* the principal, or cause *sine qua non*, of this terrible calamity.

The application of quarantine laws to our epidemic pestilential fever, is just as useless as the order of the Sultan, Achmet I. in the wasting plague of 1613, for transporting all the cats in Constantinople to the island of Scutari. The Jewish physicians told the Emperor, that the plague was occasioned by the cats; and the poor cats were dispatched into exile. Yet this did not restrain the plague.

People have for ever been mistaking the cause of the plague. In the first centuries of the Christian æra, when disputes ran high between Christians and Pagans, these sects mutually charged the plague each to the other. In 1340 the Germans ascribed the plague to the Jews, and massacred great numbers of that race. In Paris, during a plague, many protestant *heretics* were

were sacrificed for bringing the calamity upon that city; and a proposition has been made in America to stop all intercourse with the West Indies and the Mediterranean during the summer months! Astonishing blindness!

But, it will be asked, shall we have no health laws? I answer, by all means. Their utility is obvious on many occasions. Thus, when an infected fleet arrives in a port, the town is in eminent danger, of what may be called a jail fever on a great scale. The quantity and virulence of infection thus imported, have produced destructive consequences, as at Brest in 1757, where were landed in November, and placed in hospitals, about 5,000 diseased seamen and troops from ships, mostly out of De la Motte's fleet, from Louisburg, with a malignant fever on board. The effect was, that 10,000 men died in the hospitals the succeeding winter, and many of the inhabitants of Brest. But it will be remarked, that this infectious disease did not become an *epidemic* in Brest; it spread only by infection; and as soon as that was dissipated, the disease disappeared. It raged in winter, and subsided in spring. This is an important distinction always to be observed by those who guard the public health; an epidemic pestilence begins when the season or state of air favours it, and rages without control against all human efforts; the common

mon air becomes tainted, so as to produce the disease without the infecting principle from bodies or clothes; and the diseases subside only at the command of the seasons and the elements. Against such no legal provisions are, or can be of any avail; and such is usually the yellow fever of our country.

But diseases propagated only by infection, like the jail and ship fever, never put on the form of an epidemic. They rage in crowded prisons and ships where they are generated; and when multitudes are crowded into hospitals, they carry the evil with them; and all persons coming within reach of the infection, are liable to suffer. In this manner Brest lost many of her inhabitants; a town in America is said to have done the same, from the yellow fever imported in Sir Francis Wheeler's fleet, as already related. But in such cases, the infecting disease requires contact or near approach to aid its propagation; and does not assume the complexion of an epidemic. The two species of disease are as distinguishable as light from darkness.

Thus at the black affizes in Oxford in 1577, a malignant or jail fever of a singular kind was produced suddenly; almost all the court and spectators were seized: many died; but no epidemic followed in Oxford: and in this instance, the effect was so sudden, that the human body did not generate infection.

So also at the Old Bailey, not many years past, a few prisoners entering the court from a dirty jail, without changing their dress, infected a large number of persons who died; but no epidemic followed—the infection was soon dissipated, and there was an end of the disease.

With our pestilential fever this is not the case, nor with any epidemic plague that ever existed. Remove the sick, cleanse the houses and clothes, do whatever human art and labour is competent to effect, all will not avail—cases spring up in every quarter, and the disease takes its course.

So it was in Candia in 1592, as related from Thuanus, under that year. As soon as the plague appeared, all the sick and all the suspected were removed from the city; but to no purpose; it raged till July—then abated without any human means, and revived again in October.

Thus says the author of *Traité de la peste*, “Universal cleansings have proved useless; the plague has ravaged places after every precaution; and after negligence, it has entirely ceased, as in Naples.”

Such are the facts; and hence the necessity of distinguishing carefully between *epidemic* pestilence, proceeding principally from general causes in the elements, and marked by other epidemic diseases, by the failure of vegetable productions, and by the sickness or death of cattle, fish, and other animals—and *diseases merely infectious*,
generated

generated by artificial means, which *may* be communicated, which may happen in jails, ships, and camps, in the healthiest state of the elements, and which cease as soon as the infection can be dissipated by purifications and fresh air. Without this distinction, the merit of legislative and police regulations can never be duly appreciated. Such regulations applied to *epidemics*, as they continually are, prove totally futile—applied to diseases of mere infection and of specific contagion, as jail fever and small-pox, they may be, and often are, the means of preserving multitudes of lives.

It is important, therefore, that health laws should be judiciously framed and strictly executed, because there *may* be cases in which public health will be preserved by them; although they never can reach the cause, or prevent the ravages of *epidemics* which originate where they exist.

With respect to merchant-men, health laws may also be of some use, in preserving the lives of seamen and of persons concerned in the vessels. Sick men may generate a small degree of infection; but on board of merchant-men, the number of seamen is too small to infect a ship, so as to endanger public health, unless shamefully neglected.

The most danger from merchant-men is from the foul air generated, on long voyages and in hot seasons, from perishable and fermenting substances. From such vitiated air, deprived of its

vital principle, great danger may arise to the persons who first open and enter the holds; and perhaps to a neighbourhood. It is of great consequence, therefore, to use ventilators freely on board of vessels freighted with perishable articles; and to have them effectually cleansed, before they are suffered to approach our wharfs.

But I am not convinced that the air of such vessels ever yet *originated* an epidemic fever. It appears to me, that the Academy of Medicine in Philadelphia lay more stress on this cause than it deserves. The sphere of the operation of such a small morbid cause cannot be extensive; and all the foul air of the largest vessel must be so attenuated by diffusion as not to produce deleterious effects at any great distance. It may be injurious to a small neighbourhood; but I do not conceive it possible, that the noxious air of a few square yards can impregnate the whole atmosphere of a city; and as to infection from the sick, I have repeatedly proved, that this can never produce an epidemic. I will admit the *bare possibility*, that imported infection may enkindle the flame of pestilence in a place fitted for it by local causes, where no pestilence would appear without a spark from infection. This is as much as I can admit to be possible, and more than I believe, after a more minute and careful investigation of facts, probably, than was ever before made in America. Most of the cases I can find, where accurate ac-

counts

counts are preserved, of supposed importation or communication of autumnal diseases, fail utterly of proofs to support common opinion; and many of them are incontrovertibly proved to have had their origin in the places where they have existed.

It is easy, I aver, to distinguish in every case the nature of pestilence; that is, whether it is an epidemic proceeding from a state of the elements, or a disease generated solely by foul air, artificially collected. In a few weeks, if not a few days, a disease will show whether it proceeds from infection only, or from a general elemental source; and when it appears to proceed from the elements, men may just as well attempt to save the cats, the wild animals, or the fish in the ocean, from the effects of that principle, as their own species, by laws enjoining quarantine and purification of ships. The same cause that destroys the cats or the fish in one case, destroys human life in the other; and that cause exists in the elements; it is at home; quarantine laws do not reach it.

An epidemic disease may be distinguished from a disease proceeding from infection or specific contagion by the following circumstances:

- 1st. An epidemic pestilence is usually preceded by influenza, affections of the throat, or acute and malignant fevers.
- 2d. An epidemic predominates over other diseases; totally absorbing them, or compelling them

them to assume its characteristic symptoms. This last circumstance is decisive of the character of the disease.

A disease propagated by contagion or infection only is not thus distinguished. It has no precursors, it extends and spreads only by contact or near approach; and has no effect on the diseases in its vicinity. The small-pox or jail fever, depending on mere infection, never expel a dysentery or intermitting fever.

In every possible case, a plague that banishes other diseases, as I believe it always does, is an epidemic, generated in the place where it exists; for it is not possible that this expulsion of other diseases could take place, unless the epidemic depended solely on the elements. Simple infection would not change the symptoms of another disease, even in the next house, much less in all parts of a city.

To show how little an epidemic depends on infection, let us advert to facts. In all the Eastern countries, the plague is suffered to take its own course without restraint. There are no regulations to controul its progress, or prevent its return. Its beginning is usually gradual; a few die the first year; the proper season suspends its progress; the next year it is more general, and often the third year is the most fatal.

It is remarkable, that after its most extensive effects it abates and suddenly disappears. In
London,

London, the malignant precursors of the plague of 1665 appeared as early as 1661, but no sooner had its crisis passed, than in a few months it was totally extinguished. The same happened at Aleppo in 1762, and such is usually the fact.

Let any man suppose the disease to be propagated wholly or mostly by infection, and attend to the consequences. In Aleppo, says Ruffel, died 500 in 1760, in 1761 died 7000, and in 1762, 11,000. On the principle of infection, then, some sick man or a bundle of clothes first spreads the disease, so as to destroy 500 lives; the infection of 500 destroys 7000 lives; the infection of 7000 destroys 11,000 lives; and the next year the infection of 11,000 destroys—none at all!

In London a few bales of cotton, smuggled into the city from Holland in 1664, communicated infection that destroyed 68,000 lives; the infection from this immense number proves fatal—the next year to 1900 only; and these, the year following, infect only 35!—If infection has much concern in propagating that disease, its operation certainly defeats all arithmetical calculation of its physical powers!

The whole theory of infection, to which Mead has given so much celebrity, and which is maintained by many physicians in this country, is absurd and ridiculous from first to last; leading legislators, magistrates, and citizens, astray from the truth, producing most serious inconveniences

to commerce, and preventing the adoption of the only means of mitigating the pestilence to which our cities are exposed.

In Turkey and Egypt no pains are taken to cleanse houses or clothes after a plague. No sooner has a great plague ceased, which has cut off 300,000 people in Constantinople or Cairo, than the infected houses are filled by other people, who replace the dead, use the furniture and the bedding on which the infected had died; or the old clothes are sent to auction, and purchased by Jews, who retail them out for use, uncleansed; and yet, amidst all this mass of concentrated infection, no person has the plague: or, if a sporadic case occurs here and there, no epidemic ensues for two, three, or four years, perhaps longer; then all at once, when the infection must necessarily be destroyed by the action of air and water, the disease breaks out again, and becomes epidemic. Then some arrival from an infected place is hunted out, and the calamity is charged to the account of some poor seaman, or his clothes! The infection of half a million of people produces no plague in one year; but in another, the invisible fomes of a piece of cloth, or the breath of a single man, is sufficient to spread desolation over a great city, or a kingdom * !

Such

* Hodges informs us, that, after the plague in London, in 1665, people returned into houses not cleansed, and even slept in beds on which the infected had died, without fear or injury.

Such are the absurdities of the modern notions about the plague, which adorn this splendid æra of philosophy and science!

Of the nature of the infecting principle in diseases, we know very little; and even its effects are not always comprehensible. We observe a difference also in the operation of the principle which we cannot explain. Why the small-pox should be communicated under *all* circumstances, the plague only under certain circumstances, is a mystery not yet unfolded. It is supposed, that the diseased body discharges certain fine poisonous particles, which are suspended and diffused in the air, and being imbibed by the pores of the skin, and with the breath, excite the same species of distemper in a healthy body. These effluvia generally escape our sight, and very often our other senses; but they may be concentrated in such quantities as to be very obnoxious to the olfactory organs, and even to excite sudden nausea in the stomach.

But why the effluvia from the small-pox, anginas, and the measles, should be independent of heat and cold; and those of dysentery, plague, and other typhus fevers, subject to be excited by injury. This is not at all strange. Unless the effluvia from the sick have been closely confined, and are greatly condensed, they will not affect a well person; and indeed it is a difficult thing to preserve the morbid matter in sufficient quantity to communicate disease in cold weather.

into action by the one, and to be destroyed by the other, is a phenomenon never yet explained. We may say, the particles issuing from the former class are more subtle, volatile, and penetrating; but this is all conjecture. Certain it is, that the poison of small-pox, angina, and measles, is of a more distinct, specific kind, than that of the plague, less connected in its operation with putrid exhalations from other bodies, and less susceptible of grades in its powers.

So far as I am able to comprehend the nature of the infection of plague, and other autumnal diseases, passing under the popular name of putrid, it appears to consist of a species of air, which is one of the elementary parts of all vegetable and animal substances. It may be what Doctor Mitchel denominates the septic acid; that fluid which is discharged from flesh in the process of putrefaction. It may be some other species; but it is very evident, from all its effects, that it operates in producing disease no more than all the morbid exhalations extricated from every species of vegetable and animal substances in the putrefactive process. In all or most of such substances there is, it is well known, a species of air, or acid matter, which, when in a form detached from other substances, is highly noxious to health. To this fluid, or septic acid, evolved from vegetables in a state of natural putrefaction, and floating

floating in an ærial form, is ascribed the whole class of bilious fevers, which prevail near marshes.

Hence the effluvia from a person labouring under the plague are susceptible of all degrees of concentration, and in proportion to their concentration will be their violence and certainty of effect, when they attach themselves to a healthy body. In this respect the infection of the plague differs from that of the small pox. The matter of contagion in the small-pox, however small, is sufficient to communicate the disease; and it is customary for physicians to wipe clean the point of a lancet, dipped in variolous matter, before it is inserted in the skin, for the purpose of inoculation. It is also proved by experiment that the quantity of infection introduced by inoculation, whether more or less, makes no material difference in the number of pustules, or violence of the disease.

But in the plague, the operation of infection is very different. This disease, if light, produces no infection, or very little—more violent cases appear to be more apt to be communicated—and in great plagues the infection is visibly augmented. Yet in most pestilences an instantaneous exposure to the effluvia from the sick will rarely produce any effect, as in the case of small-pox and measles. It usually requires that a person should be a considerable time in the room with the sick, in the plague, to receive poisonous air sufficient to ex-

cite disease; and more generally it is not communicated without handling the sick, or imbibing his breath. In many cases all this exposure for weeks and months together will excite no disease. Hence Ruffel represents the plague as of different degrees of malignity, and not always infectious. Hence the propriety of close and indefatigable attention, in pestilence, to every article of cleanliness; for by this means the quantity of infection is reduced, and the danger diminished, from a high degree down to nothing. Not so in small-pox and measles, the contagion of which regards not filth or cleanliness.

The infection of the plague, dysentery, and the like, seems therefore to be nothing more than *an access of noxious matter to the local causes, morbid exhalations.* The noxious air of filthy streets, docks and tenements, are secondary and augmenting causes of the plague; when the disease appears, the effluvia from the diseased still *augment* these other local causes. Thus when a certain state of air, in a city, generally will produce a malignant fever, and persons are exposed to it by walking in the streets, a sick person, confined in a close room, will soon fill that room with exhalations from his lungs and pores, which will render that room more dangerous to a person in health than the open street. This seems to be the amount of the infection of plague and other autumnal diseases.

Thus

Thus also, in a violent plague, the common air of the streets becomes so highly infected, that persons attending the sick cannot possibly determine whether they take the disease from the common atmosphere, or from their intercourse with infected persons. The only cases which afford certainty in this respect are, when the diseased are removed into the pure air of the country, and nurses and visitors, who have breathed no pestilential air in the city, are taken ill in a few days after such intercourse with the sick. These would be clearly the produce of infection. But these cases rarely occur. It has already been observed, that the worst cases of pestilence removed into the country seldom infect the attendants. This shows how little apprehension ought to be excited by mere infection, and how ill founded are the alarms in the country, about the spreading of the yellow fever; alarms that often occasion a neglect of diseased fugitives from the city. People in the country have little to fear from infection, if the sick are kept in airy rooms and cleanly; they ought not to abandon the sick; for the duties of humanity are not incompatible with their safety. It is the infected ground, if I may so call it, the local atmosphere of pestilence, which is to be dreaded, and especially by strangers. During its prevalence in a city or town, the air of the place is rank poison to persons accustomed to good air.

The preceding facts and distinctions enable us to form a just estimate of the importance of Health Laws. In nine cases of ten, in which quarantine is enjoined, human efforts are opposed to the great laws of nature, and are therefore useless. In all cases where the air of a country exhibits evidences of a pestilential constitution, in an increase of the number and violence of the symptoms of common diseases; in the production of certain epidemics, as catarrh, anginas, measles, petechial fevers, and the like; in the death of fish, or the unusual diseases of cattle and other animals; in the production of insects, uncommon in size, in kind, or numbers, and other remarkable phenomena, before mentioned; in all such cases, the pestilence which invades man will be found to arise solely from the uncontrollable laws of the elements; and quarantine will be utterly unavailing to guard cities against its introduction and ravages. The remedy is not applied to the source of the disease. Hence the efforts of the police in London in the last century, and of Dantzick and Marseilles in this, were entirely useless; and hence the failure of all health laws to save our cities from the late epidemics.

Satisfied as I am of this truth, I would not lay aside the application of these laws. The bare possibility of saving the lives of a few individuals, and especially of diseased seamen, is a good reason for cleansing ships after long voyages, and of purify-

purifying their cargoes when in a bad state. But what I contend for, is, that we must not expect the best health laws, most rigorously executed, will ever be successful in guarding cities against *epidemic* pestilence. In our reliance on such regulations we expose ourselves to perpetual disappointment; we expose the lives of citizens; we overlook the true causes of the evil, and neglect the only means of preventing or mitigating its effects.

Further, the opinion of the specific contagion of the plague has originated many, not only useless, but barbarous regulations. Such is the practice of confining the citizens of an infected town within its limits by an armed force—which I am informed has been done in Europe. In Marseilles the first persons seized were confined to their houses by the point of the bayonet.

An ignorance of the nature of a disease and its degree of danger may be pardonable in a prince or the legislators of a free state: but there is a point, beyond which ignorance in medical professors becomes a crime. No science is necessary, however, to convince any man, that most pestilences proceed only from the deranged state of the elements, aided by the morbid exhalations of cities. This is a fact that may be known to a certainty by very little reading and observation. It was well known in past ages, when men were more governed by observation than by theories and erroneous reasoning.

ing. Mead's attempts to prove the specific contagion of plague, aided by his popularity, had a most surprising success; his treatise was received as a standard of truth; it every where suspended enquiries, and checked a spirit of investigation, which might have dissipated error; it was the basis of the present laws of quarantine, which are applied, in thousands of cases, where they are as improper, and as little wanted, as if applied to prevent an epidemic pleurisy, or a head-ach, embarrassing commerce without the shadow of necessity. But these are not the worst effects. The erroneous system of specific contagion has misled mankind into a fatal security on the subject of the local causes of diseases. Supposing the laws competent to guard public health, men have not attended to the best modes of constructing houses and cities, and to the means of watering and cleansing them—means by which all the slighter pestilences might be avoided, and the more severe ones greatly mitigated. Hence I am persuaded that the received theory of specific contagion is the direct cause of most of the fatal plagues that now scourge civilized Europe and America: for it will be observed that pestilence has always been the *peculiar curse* of *populous cities*. Of about two hundred general plagues, recorded in history, a few only have been so violent as to spread over countries, into villages and farm-houses; almost all have been limited to large towns,

towns, evidently demonstrating that they would never have affected mankind, without the influence of the impure air generated in those places. This is a truth as unquestionable as it is important ; and on a conviction of this hangs the safety of men from that dreadful calamity. Had Mead, and other eminent physicians, taken the same pains to lead mankind into truth, as into error, we should long ago have introduced improvements into the arrangement and structure of our cities, which would have secured our citizens from nine tenths of the infectious diseases by which they have been alarmed and distressed.

At the same time, had men understood the common operation of infection, which may be made obvious to the most ordinary minds, merchants would not, at this day, have been harassed with the necessity of performing quarantine, to guard against *epidemic* diseases. We should not have seen a ship from the West Indies condemned to the flames, in a British port, because she had lost her crew by the yellow fever ; nor merchantmen from an American port obliged to ride quarantine in the British channel, because that disease prevails in this country. Physicians, had they not been blinded by system, and taken opinions for granted without enquiry into the grounds on which they rest, would have known before this, that the yellow fever will not spread in England, Scotland or Ireland. It never shows itself in
America,

America, without a much greater degree of heat than the ordinary summer temperature of those countries. The heat in those latitudes rarely exceeds, for a few hours in a single day, seventy-five, or, at most, seventy-eight degrees by Fahrenheit. But no epidemic yellow fever is ever generated in our climate with that degree of heat. In general, we never see cases of that disease in America until we have had a period of heat rising, for a considerable time, to 85 degrees or higher. In any season of ordinary temperature, the yellow fever in the British kingdoms, and other parallels of latitude, introduced from abroad by seamen or others from warmer climates, would immediately subside, and be extinguished without any human efforts. The cases of malignant fever in England which turn the body yellow, and which sometimes occur, as mentioned by Lind, are generated about marshes, in hospitals, camps, ships, and prisons. An epidemic yellow fever, like that which prevails in America, was never known in England, and probably cannot exist in the climate. The quarantine enjoined on vessels from the West Indies and United States, is utterly useless in guarding that country from this pestilence in the form of an epidemic.

It may be said, in answer to these remarks, that the yellow fever and plague are essentially the same disease; the plague has often raged in Great Britain;

Britain; and therefore the climate may not resist the yellow fever.

But if the plague has raged in Great Britain, which is admitted, it must have arisen from the unhealthy state of the elements, which may exist in any latitude, or from very singular seasons, aided by most powerful local causes, as in London before it was burnt. I say the yellow fever will not spread in England in the *ordinary* state of the elements, and the *ordinary* temperature of the summer. If pestilence ever invades cool northerly countries, it must always proceed principally from disorders in the elements and seasons. The ordinary causes in temperate or cool climates have but little influence in generating pestilence. Hence in common seasons in England, no plague, bilious or inguinal, could be spread, unless in a crowded jail, camp, or dirty confined alley in a city. If the physicians in England observe the general state of health to be good; no epidemics, with unusual symptoms, prevailing; no uncommon numbers of insects, or diseases among cattle, or other symptoms of a morbid state of the elements, it is no more in the power of man to render the plague epidemic in that country, than the pleurisy or quinsy. I challenge all the faculty in Europe to mention an instance in which plague has ever prevailed without such phenomena.

Besides, it seems to be probable, that more heat is necessary to generate and to propagate the bilious, than the glandular plague. My reasons for this opinion are, that the glandular plague appears in spring much earlier than the bilious. It often appears in the northern parts of Europe as early as March, and often in May, when the weather is yet cool. But the bilious plague of our climate has never showed itself in sporadic cases till June, and then very rarely, and only in a few scattered cases of a less malignant type than at a later season. To this remark I have heard of only one exception. Generally, the disease does not appear till we have experienced some days of our hottest weather, and not till the last week in July, except in a few cases as before mentioned. It does not become formidable as an epidemic till the tenth or twentieth of August.

This difference seems to depend on the following circumstances. The glandular plague of Europe, Asia, and Africa, when it breaks out in the northern latitudes, as on the Baltic, or in Great Britain, seems to be more essentially and principally the product of a defective state of the elements, joined to human exhalations in large cities; both which causes are less dependant on heat, than the morbid exhalations of the vegetable world, which seem to give to our American plague

plague its peculiar character, and to be a powerful cause of the distemper. I am further confirmed in this opinion by this circumstance. A distinction between the bilious fevers of our *cities*, and of our *marshy grounds* on rivers, is observed to exist in perfect analogy with the foregoing distinction between our bilious plague and the glandular plague. The mortal fevers about marshes in the interior of our country are less infectious than the pestilential fevers of our cities, although they are at times as fatal, and are characterized by a yellow skin. These seem then to proceed *wholly* from vegetable exhalations. The fevers of our cities approach nearer to the plague of the East, because they proceed both from *animal and vegetable* exhalations; but the vegetable effluvia have a more predominating influence here than in countries which are dry and better cultivated. Hence the mortal bilious fevers of our interior country evidently form a link in the series of gradation between the common remittent and the yellow fever of our cities; just as the yellow fever constitutes a grade between our river or lake fevers and the Levant plague.

The order of bilious fevers then stands thus in connection with their causes.

In healthy Periods.

Common intermittents, } solely from marsh efflu-
remittents, } via.

In Pestilential Periods, under the operation of elemental causes.

- | | | |
|---|---|--|
| Intermittents, remittents, | { | of a worse type from marsh effluvia, aided by a general cause. |
| Bilious plague of the country, near lakes and rivers, | | solely from marsh exhalations with the general cause. |
| Bilious plague of American cities, | { | from the joint-operation of vegetable and animal effluvia, with the elemental cause. |
| Inguinal plague of the East, | | principally from animal exhalations, with the elemental cause. |

In this gradation of diseases there is a regular progression of symptoms. Intermittents and remittents exhibit a yellow skin, more or less, but no infection worth naming. The river or lake plague a very yellow skin, with morbid symptoms, but little infection; the bilious plague of cities, sometimes a yellow skin, sometimes not; and some cases of glandular tumours, carbuncle, and petechia, with more infection. The Levant plague less yellowness of the skin, and usually infection and glandular swellings. Thus in proportion as the vegetable exhalations predominate in the scale of exciting causes, there is more yellow-

yellowness of the skin, less infection, and less frequent affections of the glands; in proportion as the animal exhalations abound, as the cause, the yellowness declines, and the affections of the glands multiply with augmented infection.

It is a remark of the celebrated Zimmerman, that "exhalations from marshes do not seem to be so noxious in cold as in hot countries; yet malignant fevers occur even in Finland. In Germany these exhalations produce tertians; in Hungary petechial fevers; in Italy hemitritæa; in Egypt and Ethiopia pestilential fevers."

On Physic, p. 131.

It is therefore probable that a greater degree of heat than the ordinary temperature of Great-Britain is necessary to extricate the sceptic fluids, and give them the virulent poison necessary to generate the pestilential fever of our cities. And as no degree of infection ever yet accumulated on board of a merchantman can create a pestilential atmosphere sufficient to generate an epidemic, the fears of the English respecting such vessels from the United States or the West Indies are utterly groundless. The marsh fevers of England, Scotland, and other cool climates, are of an inferior grade. Such are the autumnal fevers near the fens of Lincoln, Ely, and Cambridge. In Tarbat in Scotland, a putrid fever sometimes
 e 7 1 1 3; and after death the body turns yellow;

this may be ascribed to certain natural lochs or ponds which sometimes dry up in summer.

Sinclair's Scot. vol. vi. 418, 428.

But these diseases, though doubtless the same in species, fall greatly short of the violence of our pestilential yellow fever, which never did, and probably never will, prevail in that climate.

It is likewise probable that a greater degree of heat than the ordinary temperature of Great Britain is necessary to extricate the febrile fluid, and give them the virulent power necessary to generate the pestilential fever of our climate. And as no degree of infection ever yet accumulated on board of a merchantman can create a pestilential atmosphere sufficient to generate an epidemic, the seas of the English westward, and still less from the United States or the West Indies are directly dangerous. The malarious fevers of England, Scotland, and other cool climates, are of an insidious kind. Such were the venereal diseases near the towns of Lincoln, Litch, and Cambridge. In Tartary is Scotland, a fatal fever sometimes and very deadly the body turns yellow.

SECTION XVII.

Of the Means of preventing or mitigating Pestilential Diseases.

THE first step towards an effectual remedy for an evil, is to ascertain its nature and cause, so far as they can be understood by effects. Primary causes are above the reach of man; proximate causes may be so far investigated in most things, as to answer all the purposes of mankind.

It has been proved in the preceding pages, and every day's observation confirms the fact, that one influential cause of epidemic diseases must exist in the elements, independent of human controul. In the production of epidemic catarrh or influenza, for instance, no human or artificial means appear to have any share of influence. In the measles artificial causes sometimes modify the symptoms, but have no great share in its production or propagation. A similar remark will apply to every species of angina. The small-pox is also modified in its force and symptoms by many local circumstances; and its propagation is chiefly by means of contagion; but this disease also is sometimes, though rarely,

generated in particular bodies without contagion. The appearance of those diseases in the form of epidemics, excepting the small-pox, which may arise from contagion, always indicates a pestilential constitution of air; and during this constitution, ordinary or annual diseases, which depend on season or local causes, assume more violent symptoms.

Autumnal diseases of the annual or ordinary kind, though rendered more violent, fatal and extensive, by a pestilential state of air, are, however, generated by subordinate causes, most of which are within the power of man. The dysentery depends partly on season, partly on situation, as to pure air, and partly perhaps on the imperfection of autumnal fruits. Sometimes it arises in camps from bad diet, or want of shelter from the weather; and when it once exists, is more or less propagated by infection.

Bilious fevers of all grades are produced usually by miasmata or morbid exhalations, from low, damp, marshy, grounds, where vegetables, in the hot season, are in a state of rapid putrefaction. These fevers occur annually, and with a violence of symptoms proportioned to the extent and force of the morbid cause. The origin and phenomena of all this description of diseases are so well known, as to render any observations of mine unnecessary.

The plague, glandular and bilious, seems to be nearly allied in its symptoms to the ordinary bilious

bilious remittent. The point seems not altogether settled, whether the contagious yellow fever, as it is usually called, and the common sporadic yellow fever of the West Indies, and the bilious remittent, are different grades of one species of disease, or whether they are of a distinct species.

On this point, however, the late epidemics have furnished our scientific men with proofs that appear to me to decide the question in favour of the identity of the species. The evidence arising from the disease in Baltimore, is alone sufficient to decide it, as far as regards the yellow fever and the remitting; and the Academy of Medicine in Philadelphia is a most respectable authority in favour of the same doctrine.

That the glandular plague of the Levant, and the bilious infectious yellow fever of our country are specifically the same disease, I have no doubt; but they take some different symptoms, either from climate, or other causes unknown. The glandular tumours are held, by most writers on the plague, to be the characteristics of the disease, which alone decide its nature, and distinguish it from other malignant fevers. But Diemerbroeck, and all the best authors agree, that these external swellings are not essential to the disease; and that many have the true plague without them. They are, however, the usual marks of the disease.

In our bilious pestilence these swellings are less common. But, though rare, they sometimes appear in the most unequivocal form of the true pestis. I saw an instance in 1796; and they were more common in the last epidemic.

The yellowness of the skin has given name to the pestilence of our country; yet this is a misfortune, for it may deceive a common observer. A yellow skin often accompanies lower grades of bilious fevers, not pestilential; and is by no means essential to the infectious yellow fever. In all our late epidemics persons have died without exhibiting this colour of the skin; and it has been less common the last year than in former years. It appears then, that the lighter the epidemic disease, the more common the yellowness of the skin; and *vice versa*. This is no inconsiderable proof of the identity of the bilious and inguinal plague; that, in proportion as the bilious plague of our climate becomes violent, and approaches the true plague, it loses that yellow colour of the skin, and assumes the glandular swellings. This, I am informed, is the fact, as observed by the Physicians in New-York the summer past. There are, however, some differences in the symptoms of the two species of the plague, which it belongs to the faculty to observe and define. It may be that the moisture of our country, not yet cleared of its woods, and abounding with swamps and marshes, may occasion

sion the difference in the symptoms. The parts of Europe, Asia and Africa, where the plague most usually prevails, are clear of woods and cultivated. Perhaps an increase of population, and human effluvia, with a decrease of vegetable exhalations in America from cultivation, may, in time, change the form of our pestilential fever into the true inguinal plague. I have reasons for believing such a change actually took place in Rome. Some of the plagues described by Livy were obviously of the bilious kind, similar to our epidemic fever; but in later periods, the plagues in Rome are expressly described to be "*pestis inguinaria*."

However this may be, the causes of pestilence I suppose to be; first, some essential alteration in the primary qualities of air and water, owing to seasons or the action of electricity, the main operative agent in the earth and atmosphere; which alteration is demonstrated by various epidemics, and specially by catarrh. Secondly, the subordinate causes of plague are noxious exhalations of every kind, which diminish the proportion of vital air imbibed into the lungs. Both causes appear to produce disease, either by excessive excitement, inducing *indirect* debility; or by reducing excitement, and inducing *direct* debility. The aerial, or elemental cause, seems to produce excessive excitement; for its first effect appears in catarrh, a disease of stenic or inflammation.

inflammatory diathesis. Thus the present epidemic constitution was introduced by influenza of universal prevalence, and of severe symptoms.

Measles, another disease that rarely fails to characterize the early stages of a pestilential constitution, is also of an inflammatory diathesis. The same is true of the common distinct small-pox; another disease which, before the art of inoculation, seldom failed to rage in cities during such a constitution.

Anginas are of different types; some of the milder kinds are ranged by Brown among stenic diseases; but the angina maligna he considers as astenic. Diseases of this class, however, form a part of the effects of the pestilential constitution.

Next to this species of diseases, may be arranged the petechial fevers, which under the names of *purple* or *spotted*, have often overspread Europe, and rarely fail to precede the plague. These are the product of the last stages of a pestilential constitution, next to the true plague, which marks the crisis. These forms of malignant fever have never occurred in America as epidemics; but purple and livid spots, vibices, and all the varieties of eruptions which belong to that class of diseases, occur occasionally during pestilence.

It is a remarkable fact, and one that seems to have escaped observation, that a pestilential constitution

stitution of air, in all ages and countries, produces epidemic disorders of the *eruptive* kind. I question, whether, in a single instance, since the days of Moses, the real plague ever became epidemic, without one, two, or all of that kind of diseases for its precursors. We cannot look into an author who has described the diseases which prevail in such a constitution, from Hippocrates down to our time, but we see *ignes sacri*, *variola*, *morbilli*, or other eruptive disorders, constituting a part of the description. These diseases seem evidently to be classed by the laws of nature, and always to appear in close connection.

Hence the propriety of Sydenham's observation, p. 120. that "the *erysipelas*, *ignis sacer*, is a good deal like the plague, and sometimes accompanied with pains in the glands; that it begins much in the same manner as the plague; but the plague is much more violent than an *erysipelas*."

Hence also we observe, that Hippocrates, in describing a pestilential constitution, mentions that before spring appeared "*eruspilata polia*," many cases of the *erysipelas*; of a bad type, and mortal.

De Morb. Vulgar. Sec. 2.

This is a curious phenomenon, and worthy of investigation, that a particular constitution of the atmosphere should, in its different stages, or in different

different seasons of the year, tend to generate all those diseases which throw out upon the surface of the body petechiæ, vibices, a general efflorescence and tumours, with various other appearances. It belongs to medical men to explain the general proximate cause, which, while its effects are various, still gives to diseases some common similitude.

In America the pestilential constitution exhibits the same phenomena as measles and anginas, but without the purple or spotted fever, as the precursor of our pestilence. The immediate precursors of the bilious plague in America, are catarrhus affections, disorders of the throat, and especially bilious fevers of a bad type, ending often in black vomit. Detached cases of this latter disease rarely or never fail to introduce or precede the infectious epidemic.

But no disease whatever seems more closely connected with pestilence than catarrh. An epidemic influenza is almost invariably the signal of the approach of a pestilential constitution; and during the whole existence of the constitution catarrhus affections are frequent in particular seasons, especially just before or after the prevalence of a pestilential fever. This circumstance affords no inconsiderable evidence, that what we call an epidemic constitution acts upon the human body as a violent stimulus. The first diseases excited by it are usually of the inflammatory

matory diathesis, as catarrh and measles. Hence, perhaps, we derive a clue to explain the mystery of the pestilential diseases which succeed.

The continued effect of excessive stimulus must be debility. The epidemic constitution, when it first commences, is mild, and produces stenic diseases, not very mortal, as catarrh and measles; for a very obvious reason, the force of the stimulus is not at first sufficient to hasten on the indirect debility of the system, or to produce the astenic diathesis in a fatal degree. But as this state of air advances in strength, the stimulus is greater; and when aided by the heat of summer and noxious air, produces a degree of excitement that speedily induces universal debility. Hence the pestilential fevers of summer and autumn seem to be the effect of excessive stimulus, acting upon the system with such violence as to produce speedy debility; in consequence of which, all the functions of the system are weakened and deranged, the stomach does not digest food—the peristaltic motion is imperfect and feeble—the liver and gall-bladder do not perform their secretions—the energy of the brain is diminished—the extreme vessels are relaxed.—The consequence is, that part of aliment which ought to be separated and carried off by the intestines as the hepatic fluid, are retained, and forced out of their proper ducts into other parts of the system, where they excite external eruptions, efflorescence, or yellowness in every part of the body, becoming
rank

rank poison, and speedily inducing fever, morbid affections, and dissolution.

This process is infinitely modified by subordinate causes; as seasons, which are extremely various; local exhalations and stagnant air, which are deleterious according to their force; the various modes of living, which strengthen or weaken the human body; and accidental circumstances, as fatigue, grief, fear, exposure to excessive heat, or sudden cold; and innumerable similar causes.

This idea of the proximate cause of the bilious plague of our climate was imbibed from observation and conversation with physicians before I had read Brown's Elements of Medicine. I am happy enough to find, on reading that work, a confirmation of the opinion. That author observes, paragraph 137, "Sometimes the secretory vessels seemed crammed with a calluvies of fluids, capable of producing indirect debility, as in that overflowing of bile which distinguishes the yellow fever of the torrid zone."

This "calluvies of fluids," lodged in the secretory vessels, seems to act like poison in disorganizing the system. And the reason why the plague is so often incurable, seems to be the rapidity and the imperceptibility of the action of that poison, which appears totally to undermine the vital powers, before it exhibits much pain or fever. This is not its common mode of operation; but it is not unfrequent. Cases of this

this kind are soon characterized by a total prostration of strength, a cadaverous look, and a dull, glassy, languid eye, so often described by medical writers. In such cases debilitating remedies precipitate death, and stimulants are ineffectual to revive the languid functions.

In most cases, however, the approaches of the disease are accompanied with pains, uneasiness, and febrile symptoms, while the system yet retains its stenic diathesis; in some such cases, debilitating remedies are useful, but the rapidity of the progress of the poison soon changes the diathesis to astenic.

Boyle remarks, vol. i. p. 678, "that a day or two before the plague has manifested itself in some persons, their vision has been affected, objects appearing diversified with beautiful colours. A vomit administered to such usually gave relief." Every observation of such eminent men deserves consideration; but I do not remember to have found the same in any other author. If just, is it not an evidence that the state of air, inducing the disease, operates *first as a stimulus*?

Procopius has recorded of the plague of 543, a phenomenon somewhat similar to that noticed by Boyle. He says, persons imagined they saw phantoms or ghosts, which made them suppose they were smitten by some person. Such as had this imagination, soon perished with the plague.

In 746 also, persons were troubled with phantastical images which filled them with terror.

See also the plague in Carthage, before Christ, 404.

General appearances favour the idea, that what is usually called an epidemic state of air, produces, in the human system, unusual excitement by excessive stimulus. But then how shall we account for the angina maligna, a disease of extreme asthenic diathesis, which often forms one of the series of epidemics belonging to the same constitution?—Is this also the effect of excessive excitement, inducing great debility?—Is not its prevalence principally among children of sound health a proof that it is the consequence of indirect debility?

However these questions may be decided, certain it is, that under the same constitution, and during the same pestilence, the fatal diseases assume very different symptoms, and exhibit, in different bodies, a different diathesis.—In all epidemics of this sort, a principal object of the physician is to ascertain the general diathesis produced by the constitution of air, and the various effects of it in different bodies.—“*Hic labor, hoc opus est* *.”

The

* Is not the doctrine of indirect and direct debility, as the source of all diseases, fully implied in the first paragraph of Aristotle's first Problem?—It may be thus rendered:—

“Why have great excesses a tendency to produce disease,

but

The secondary or auxiliary causes of plague, coming under the denomination of *impure air*, are supposed to act upon the system by directly debilitating powers. "It cannot be doubted, says Brown, p. 145, that the application of air to the whole surface of the body is a necessary stimulus. The air is seldom applied in a pure state; it is commonly blended with *foreign matters that diminish its stimulating powers*; and though its salutary stimulus depends upon its purity, it is uncertain whether ever its purity goes so far as to stimulate in excess, and thereby produce stenic diathesis."—I know not what this author would call "purity of air," but I am very certain that an epidemic influenza proceeds from some qualities in the atmosphere; and this author agrees the disease to be a stenic diathesis.—If the disease is the effect of "foreign matter," infused into the air, then this foreign matter is a stimulating quality.

I suspect, however, that the atmosphere should be considered as composed of two principal substances, *air* and fire, or *electricity*. Morbid matter floats in the *air*, but the principal stimu-

but because they occasion too much or too little excitement, in which all diseases consist?" If this is not the precise idea of the author, his doctrine leads to the same results as those which form the ingenious Brunonian system. Many things appear to us new, which are 2,000 years old; and solely because we neglect ancient authors.

lating power probably consists in the *electricity* of the atmosphere.

The influence of morbid exhalations from putrefying substances, is, probably, to diminish the stimulant power of the atmosphere, inducing direct debility.—The lungs receive, at every breath, a certain quantity of air; that is, about the same cubic quantity. A certain portion of this is vital air, oxygen, which serves as food for the lungs and blood, and which is separated from the rest and absorbed. Whenever therefore common air is impregnated with an undue proportion of hydrogen, or with any species of acid which is hostile to the lungs, these viscera want their proportion of food or stimulus; the consequence is, their action is weakened, and the heart and arteries want their due force; the effect of which is a more feeble circulation of blood. Perhaps also, the septic acid, conveyed to the blood with common air, at every inspiration, gradually destroys its texture.

Sorbait mentions, that a lighted candle, being placed near persons dying with the plague, a livid vapour has been seen issuing from their mouths.—Extremely vitiated must be the air from the lungs before it can be rendered inflammable.

But whatever may be the process, we know the effects of respiration in air vitiated by morbid exhalations to be fevers of various kinds, as intermitting, remitting, dysenteric, and putrid, or pestilential.

That

That state of the atmosphere which I call *pestilential*, has a singular effect in increasing the irritability of the nervous system, by which means slighter causes than usual occasion dangerous inflammation.

Having then arrived at the probable causes of the pestilential fevers which afflict the earth, we are prepared to consider the means of prevention.

The first article under this head is, the removal of all local causes of disease; such as every species of putrescible substance, which, in the process of putrefaction, emit a species of air highly unfriendly to health. It will be observed, that I speak of *putrescible* substances; for flesh or vegetables, which have undergone the process of putrefaction, or of digestion in a healthy stomach, discharge little or none of the pernicious acid.

Hence we observe, that people in cities rely too much on cleansing their streets to preserve public health. Experience proves that the utmost care in cleansing streets will not always prevent pestilence. The reason is obvious; most of the filth of streets consists of excrementitious matter from horses or oxen, which has undergone the process mentioned, and contains no septic acid, or very little. Hence the accumulation of dung in the farmer's yard is not known to generate diseases.

Various other substances, thrown into the streets of cities, are more pernicious; as green vegetables, the garbage of fish, lees of fermenting liquors, and many others, which, in hot weather, soon putrefy and discharge noxious air. Such substances, however, ought never to be thrown into the streets in hot weather; they should be thrown into the ocean, into rivers of running water, or what is better still, *buried*; and that before putrefaction begins. If putrefaction is begun, they should be removed in covered vessels.

The vaults of Cloacina, although they contain mostly substances which have passed through digestion, and in their unmixed state are not *very* pernicious, yet they are always mixed with other substances, which, in hot weather, bring on fermentation. These should be either cleansed annually in spring, or the matter in them neutralized by quick-lime.

All filthy substances should be removed from streets, both for the sake of decency and health. If the pavements of streets could be covered with pure earth, it would greatly lessen the heat; but this is not practicable. The only effectual remedy is, fresh running water—the only article that unites cleanliness with coolness. Nothing in a city can be an adequate substitute; for while it removes the cause of noxious vapours, and by cooling the sultry air of a city prevents debility,

it extricates a considerable quantity of new and wholesome air from its own substance.

Streets should be so constructed as to give the water a considerable velocity. The practice of levelling the surface of a city is most pernicious. If possible, every street in a city should have a descent of fifteen or twenty degrees. Instead of levelling the earth, the police of a city should counteract even a natural level, by throwing the whole into artificial elevations, which give a brisker currency both to water and air.

Cellars should be so constructed as to retain no water, and often cleansed by scraping. If the surface of a cellar can be conveniently changed, by removing a few inches of the old earth, and introducing that which is fresh, it would be a very salutary labour. Nothing imbibes and neutralizes infectious matter more readily than fresh earth.

The liberal use of water, in and about a house, cannot be too seriously recommended. Water absorbs all noxious matter that comes in contact with it in substance.—Applied to floors, wooden, stone or brick, walls; to clothes, to furniture, to back-yards, and streets; it is every where salutary in the summer months. Dr. Priestley observes, that water purifies vitiated air by absorbing the septic part. Hence its great utility as a preservative against pestilential diseases.

All dead animals in a city, or its vicinity, should be buried or burnt; as cats, dogs and horses.—The indecency alone of suffering their carcases to putrefy before the eyes of mankind, ought to make it a strict article of police to remove them; but they should be buried; not one should be permitted to offend the eyes or nostrils of a citizen *. They are offensive to decency, to moral sentiments, and to health. The ancient method of burning dead bodies was well calculated to destroy the poison; but in Atlantic America burial is cheaper and equally effectual.

Common sewers are often common nuisances. In cities, all filthy substances should be conveyed off from the visible surface of the earth, unless sewers could be so constructed as to deposit, with certainty, all their contents in running water. Serious evils arise from putrid substances lodged in sewers that are too level, and which serve as reservoirs instead of canals, accumulating putrescible matters, in places where their exhalations, by the influence of moisture, are doubled, instead of being removed.

In cities, where all filth is naturally cast by rains into the docks, it would be well that all wharfs should be so constructed, as to present a

* From two years observations, made as I passed daily from New York to my residence in the country, I judge from twenty to thirty worn-out cart-horses die and putrefy in the suburbs of that city every year.

smooth uniform front to the stream, and be extended into deep water. Mud, washed by the salt tides, and not mixed with putrescible matters, produces no inconvenience to health; but such matters thrown into docks bare at low water, and exposed to a hot sun, dissolve most rapidly, and generate morbid vapours. Many improvements are yet to be made in our sea ports, which will lessen the accumulation of pernicious air.

A great and most desirable article in a system for the preservation of health, is, the purifying of rooms from air which has been respired for a length of time. By experiment it is found, that the air of rooms that have been slept in, is very insalubrious; and probably more so than the air of privies, which is found to contain less noxious air than was formerly supposed. See *Encyclopaedia*, Art. Atmosphere. Indeed, it is questionable whether there is any necessary connection between offensive smells and insalubrity. Nature has kindly provided that dead *foeces* should not be very pernicious to health; but the effluvia of living and fermenting bodies are to be avoided as rank poison. In this respect, cleanliness is made essential to health.

It is impossible in a work of this kind to enter upon the details of cleansing a great commercial city. The magistrates, aided by medical men, in every city, will attend to the minute regulations for preserving a pure air.

But

But there are other causes of autumnal diseases, which must not be overlooked.

It is remarked by writers, that the diseases from marshes and stagnant waters are most violent near their sources; and gradually abate in their violence, and become less common, as they recede from their sources. See Buil on the Marsh Fevers at Sheffield. Medical Repos. vol. i. 457. Hence in a country generally mountainous or hilly, dry, and salubrious, but containing here and there a pond of dead water or marsh, the bilious fevers generated by the effluvia will be local, rarely extending one mile and a quarter from their source.

But there are some extensive marshes which may produce effects to a much greater distance. Such are the low grounds in Hungary, a sickly region; the Pontine marshes near Naples, which may affect the health of people in Rome; the flat lands and rice plantations in Bengal on the Ganges; the coast of Terra Firma in South America, and the marshes from East Florida to the Delaware in North America. The fens in Cambridge, Ely and Lincolnshire, in England, may be classed with those abovementioned, but are of smaller extent.

It is an opinion in Constantinople, that the frequency of the plague in that city, is to be attributed to the northerly winds, which come from the marshes in Tartary and Russia, bordering

ing on the Euxine, sweeping that sea, and conveying moisture and noxious exhalations.

The position of that city is otherwise a healthy one—the climate is temperate—the site of the city high, dry, and rising into hills and mountains on the west. No cause of unusual diseases can be found in the neighbourhood. The causes within the city are powerful. Many of the streets are narrow, filthy, crowded, and almost obstructed by pent houses. But in this respect Constantinople is not worse than one half the cities in Europe. Shall we then admit that winds will convey morbid exhalations several hundred miles, without dissipating them, so as to render them innoxious? Let us attend to other facts.

No city in Europe, except Constantinople, has been more frequently desolated by plagues than Rome, from the time of Romulus to the close of the last century. Shall we ascribe this to the vast marshes which border the shore from the mouths of the Tiber to Naples?—Certain it is, that Rome has ever been considered as a very unhealthy city; and the terrible plagues which ravaged it when in the utmost prosperity, as well as in modern times, justify this opinion. So sensible have the inhabitants been of the prevalence of this opinion abroad, and the ill effects of it in preventing strangers from resorting to the city, that Lancisus, an eminent physician of the present

sent century, wrote a considerable treatise, evidently with a view to remove this opinion.

This author observes, that south winds at Rome, if violent, humid, with clouds and heat, produce inconvenience, and if they pass over marsh, they may bring "*particulas lethiferas*," very pernicious vapours, which produce pestilential diseases.

The Romans very early took measures to correct the evils to which the city was exposed.—The enormous *Cloacæ*, or sewers, were raised at a vast expence, to carry off all stagnant water, and dry the soil, and while kept clean, were very useful. Hence Cloacina was deified as the Goddess of Health. These sewers were under the care of certain officers, called "*Curatores Cloacarum Urbis*." In one instance these drains had been a long time neglected, and were cleansed at the expence of a thousand talents. Severe laws were enacted, prohibiting individuals, under penalty of a fine, to suffer water to stagnate.

Lancisus ascribes the severe diseases which afflicted Rome, in the decline of the Empire, to the destruction of the aqueducts and neglect of the sewers. In 1695 when the ditch of Adrian's tower, and the great sewer of the city Leontini were filled with filth, immediately on the blowing of the south wind, began pestilential diseases. By order of the Pope, at this author's suggestion, the streets, vaults, ditches, and all similar places, were

were thoroughly cleansed, and ten years after no epidemic malignant disease had appeared. He however observes, that when a south wind blows *for a long time*, acute fevers, tertians, pains in the head and vertigo, become epidemic. This must be occasioned by the debilitating effects of that wind, or by *miasmata* conveyed from a distance, possibly from the Pontine marshes.

See Lancisus, *passim*.

Egypt is a flat country, containing not much marsh, but annually overflowed, and subject to most of the inconveniences of marshy countries, from the drying of its moist surface in very hot weather. Here again we have a nursery of pestilence.

The banks of the Euphrates and Tigris are nearly in the same predicament, and Bassora is in Persia, what Cairo is in Egypt.

Most of the coast of South America, from Carthagera to the Oronoke, is bordered with marsh, and is every where sickly.

But what shall we say to the marsh on our own shore? The low swampy lands that border all the rivers in the flat country of Maryland, Virginia, and the Carolinas, and the immense tract of bog in Virginia called the *Dismal*? The effects of them on the neighbouring inhabitants are well known—annual and almost universal intermittents, and often remittents.

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Is it not possible and probable, that the noxious exhalations from these vast hot-beds of putrefaction, are borne on the south-westerly winds, which prevail almost constantly in June, July, and August, and which run parallel with the general tending of the coast, from Florida to New York? Do they not impregnate the whole atmosphere for a considerable breadth, and sweep the country from the eastern shore of the Chesapeake to Philadelphia, New Jersey, and in a slighter degree to New York? I do not give a positive opinion on this subject; but the annual prevalence of slight intermittents on York Island, and in the city, though far removed from any marsh, and continually ventilated by sea breezes, as well as washed by rapid tides, affords some ground to believe this suggestion.

It is confirmatory of this idea, that soon after leaving York Island towards the east, all intermittents disappear; unless in a very few places, when they proceed from obvious local causes—now it must be observed, that the coast of the United States, runs generally from South-west to North-east; but at New York it takes a different course, and runs about east by north for two hundred miles. This course soon carries the people, on the shore, beyond the reach of the supposed stream of morbid vapour from the southern marshes, whose course is with the south-westerly winds.

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I am not attached to this idea; but it is in conformity with the opinion of the insalubrity of the Euxine winds at Constantinople, and with the effects of the southerly Calabrian winds blowing over the Pontine marshes towards Rome. Lancisius relates a remarkable fact. Thirty gentlemen and ladies went on a party of pleasure towards the mouth of the Tiber. The wind shifted suddenly and blew from the marshes, "*paludes ostienses*," and twenty-nine of them were immediately seized with a tertian. If such was the effect of the vapours from those marshes, we may suppose the vast Pontine marsh would poison the air to a much greater distance.

That the extensive morasses along our southern shore are pregnant with mischief to that country is certain; that the people of Philadelphia and New-York are affected by them, may be possible. It would therefore deserve consideration, whether the evil will admit of a remedy. There are two modes of rendering marshy lands and stagnating water salubrious—one, by draining the lands and cultivating them; the other, by turning into them streams of running water. It is probable, that most of the marsh at the southward, being within reach of tides and below high water, is incapable of being drained. It is the Pontine region of North America. How far the second plan can be applied with success, I have not the local knowledge of the land and rivers to determine.

The

The classic reader will recollect the instance related in the history of Empedocles, the Sicilian philosopher and poet, who put an end to pestilential diseases among the Salacentii, by turning two streams of good water into the marshes from which they originated.

If there is a possibility of drying any of the lands now covered with poison, or of putting the dead water into motion, the United States have a vast interest in effecting that object; and expences are not to be put in competition with the health and lives of our citizens.

The same remark is applicable to all the marshes in other parts of the country, as about some of the lakes; and to all smaller sources of disease, swamps and ponds. In every possible situation, when stagnant water contains vegetable substances in abundance, diseases must prevail. Running water, on the other hand, is salubrious. It not only does not exhale morbid air, but it generates fresh and pure air; at the same time, it creates a gentle breeze by its current, which helps to dissipate any noxious particles in its neighbourhood which may arise from other sources.

People in the country cannot be too careful in selecting a spot for their habitation. The question, of continued health or disease, of long life or premature death, hangs very often upon the choice of a salubrious situation for a house. A farmer should never plant his dwelling by the side
of

of a marsh. Whatever may be the situation of his land, he is inexcusable if he builds his mansion within a mile of the sources of disease and death. Better for him to go a mile and a half to his daily labour, enjoying robust health, than to live within the circulation of poisonous vapours, afflicted by diseases for three months in a year. And when a farmer has the misfortune to be obliged to labour occasionally in the vicinity of stagnant water, he should be careful not to enter upon the ground early in the morning, before the noxious vapours have been raised and attenuated by the heat of the sun; nor should he continue there late in the evening.

People in the country should select hilly or elevated situations for their houses, where the surface of the earth is dry, and there is a free circulation of pure air. There is another reason—the water on high ground is always better than in low, swampy places. Water in flat land stagnates beneath the surface, as well as above; but on hills, it is in constant motion. Hence if men expect good water, they must seek for it on mountains, hills, and rising grounds. The Arabians advise that houses should be set on high, airy places, near fresh water.

When a choice of difficulties occurs, and men are compelled to live near marshes, they should endeavour to place their dwelling on the windward side of the marsh, which in America is the

south and west; the summer winds being from these points. This will often make a prodigious difference in the state of health.

The fables of antiquity are mostly obscure and not well understood by moderns; but some of them are easily explained, and contain most excellent lessons. The story of Python, the huge serpent which alarmed and infested the world until he was slain by Apollo, is of this kind. Python was generated by the action of heat on the mud and slime which covered the earth, after the recess of the water of Ducalion's flood. That is, Python was disease, proceeding from noxious exhalations in hot seasons, which was destroyed by Apollo, the Sun, which dried and purified the earth.—See Ovid *Metam.* lib. i.—This fable had its origin in Egypt, where Python was killed by Isis and Oxus.

Of what consequence is it that we read books, if we neither understand nor practise the lessons they contain?

But after attending to every circumstance that can assist in guarding health from the annoyances that are local and visible, we have a further task to perform, to lessen the effect of that elemental principle of disease, which has been proved to exist in every clime at certain unequal periods. If, it will be said, such a cause of epidemic diseases does in fact exist and operate on every species of life, vegetable and animal, this cause is
above

above human controul; all our efforts to avoid its effects are useless; and we are doomed, by the decrees of Heaven, to be the victims of pestilence without hopes or remedy.

To this I answer, that if all history is not a forgery, the state of the elements has, in a few instances, been so ill-adapted to support health and life, or so positively pernicious, that men have perished by millions in the most healthy regions, exposed to no local causes of disease whatever, except such as exist in the most healthy periods.

This I must believe; but the fact affords no grounds of complaint against Providence, for the same fate has attended all other species of animals. The horse, the ox, the sheep, the dog, the cat, the fowls, and the fish, are subject to the same universal law of the physical world; and on what principle will man arraign this disposition of all-created life, or claim exemption from the laws to which all other species of animals are subjected?

But we are not altogether without hope, even in the desperate circumstances mentioned. If we attend to the causes of plagues, we shall find they all tend to destroy life by *one general effect*, which is *debility*. Either directly or indirectly, all the exciting causes close their operation on the system, by inducing *debility*, leaving the nerves,

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muscles,

muscles, and intestines, in a relaxed, languid state.

If this principle is just, and it is agreeable to the medical idea that debility is the cause of all fevers, we have a clue that will lead us to the means of escaping the evils of pestilence.

In the morbid state of air, producing the uncontrollable pestilences which have assailed man in the healthiest situations on the globe, we observe, that the most terrible effects have been produced in seasons when the air has been warm, humid, unelastic, with light southerly breezes; as in the reign of M. Aurelius, of Gallienus, and Edward III. This state of the air served very much to aid the pestilential principle in debilitating the human body. All local causes probably tend to the same effect.

The great desideratum then is, how to counteract the debilitating operation of those causes, and *preserve the tone of the system*. I am persuaded that all the means of prevention are comprised in that idea. No man is taken ill with this furious disease, until his nervous system and his intestines cease to perform their usual functions, and secretions are suspended or diminished. Hence persons, as long as their evacuations are regular, may walk with safety in the most infected places, until their eyes and their colour exhibit the poison that is imbibed; yet they will not suffer by the disease,

ease, while the vessels have strength to discharge the morbid matter by regular evacuations. This is a known and a common fact.

Hence some persons, and even physicians, have resorted during the plague to small doses of calomel, or other purgative, to keep open bowels. A most pernicious practice to those in health, for it induces the very evil meant to be avoided, *debility*; and ultimately, the intestines becoming unable to perform their functions, disease and death ensue. I am well informed of a number of cases of this kind in New-York, the last summer, which ended in death.

The true means to preserve the natural tone of the body, are the *most natural means*.

First. Food is the natural stimulus of the system. During pestilence, therefore, this article demands the first notice. It is agreed by all writers, and observation justifies the opinion, that temperance is essential to health during a sickly season. Some persons, mistaking temperance for abstinence, have run into an extreme of abstinence, which has been fatal to them. The true point to be observed is, to take as much food and drink as will sustain the body in its usual degree of strength, without overcharging it with stimulus. Too much food produces unusual excitement, which is followed by indirect debility, a state of body which invites an attack of pestilence. Too little nourishment, on the other hand,

hand, induces direct debility, a state equally favourable to disease. I have good grounds for believing some very valuable citizens of New-York, of my acquaintance, fell sacrifices to their excess of caution in the use of food during the last epidemic.

It is not improbable that different constitutions of air, as they produce various symptoms in the same diseases, may require or admit of very different degrees of stimulus, applied to the human body. The epidemic in New-York in 1795, like that in Philadelphia in 1793, was characterized with inflammatory diathesis more frequently than 1798. Hence venesection, which had acquired great celebrity in 1793, lost part of its credit in 1798, and was used with more discrimination and caution.

I suspect the same circumstance has changed or modified the opinion, of the great utility of abstaining from generous diet and liquors. This opinion was general and well received in 1795; nor have any cases come to my knowledge, in which the practice was supposed to be injurious. But in 1798, many instances occurred when persons of the most slender habits, of strict abstinence from stimulating diet, and who weakened the system by purges, were seized with uncommon violence by the pestilence and perished. On the contrary, I am acquainted with several physicians, who took their usual quantity of food, with some

wine, and more than their customary quantity of porter, who attended the sick through the season, visiting the most infected places, without suffering the least inconvenience to their health.

If the point is admitted, that debility is the great proximate cause of this disease, which I think cannot be contested, the consequence is plain, that whatever tends to reduce the vigour of the system below its usual standard, must be prejudicial during its prevalence. Hence the propriety of rather increasing than lessening the usual quantity of food, or natural stimulus; carefully avoiding, at the same time, all excess in eating and drinking, which is equally dangerous.

Another thing to be observed in summer, and especially in time of pestilence, is the guarding the body, but by all means, the head, from the direct rays of the sun. Nothing is more dangerous than the burning heat of a clear sun in sultry weather. It often produces sudden death, by means of an apoplexy, instances of which are related under the year 1752 to have happened in Charlestown; and the same is said to have taken place there the summer past. In other cases, the effect is, what is called a stroke of the sun, "*coup du soleil*," which is not always fatal, but very dangerous.

But the most general ill-effect of exposure to a hot sun is, great debility in consequence of the violent and unnatural excitement; and this effect

is most to be feared in the nervous system when the heat has fallen directly on the head. Convalescents from bilious fevers have occasion to be particularly cautious not to expose themselves to a hot sun; a relapse is the most certain consequence.

The umbrella is an excellent invention; it would be still more excellent if it could be improved, so as to render the shade more general, and completely intercept the rays of the sun, without being rendered too heavy.

In walking the streets of a city in a clear hot day, the passenger will naturally seek the shady side. Of so much importance is it thought, in some hot countries, to shield the body from the rays of the sun, that very discerning men contend that narrow streets and high houses, in cities, contribute to the health of the citizens, by mitigating the heat. They suppose the obstruction of air a less evil than a hot sun. Of this opinion was Lancisius.

But this is to embrace one evil in shunning another. It is to be regretted, that the best mode of shielding men from a hot sun is not adopted in cities. Wide streets, bordered with rows of trees, would be infinitely preferable to all the artificial shades that can be invented. Trees are the coolers given to us by nature. They make a pleasant shade; they imbibe the septic fluids, which impregnate the atmosphere of cities, and
poison

poison their inhabitants; they exhale pure air; they fan the earth, by creating or augmenting currents of air with the vibratory movements of their leaves; they invite the feathered tribe to light on their branches, and with the music of their notes to relieve the ear from the grating of rough, unnatural sounds, which stun the citizen.

It has been objected to trees, that they increase the danger of fire, by obstructing the free use of engines. This objection is imaginary. Few cases would occur, where trees, properly placed, could interfere with the operations of extinguishing fire; and in such cases they might be levelled in a moment.

It has also been objected, that trees obstruct the free circulation of air. This is not true. In calm summer weather they very much increase a light breeze, by partly obstructing the upper current with their branches, and throwing more air below; thus augmenting the under current on the surface of the earth, where it is wanted. The leaves and branches also, by their gentle motion, agitate the air, preventing the ill-effects of stagnation; and give velocity to the air that finds its way through their interstices.

“The streets and public squares of a city,” says St. Pierre, “should be planted with great trees of various sorts. A city built of marble would,
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to me, have a melancholy appearance, unless I could see in it trees and verdure."

Studies of Nature, 13.

Trees and all green vegetables diminish greatly the heat near the earth; and little do men in general think how prejudicial to health is the operation of the extreme heat of cities.

It is not an uncommon thing in the country, when no miasmata exist, for labouring men to over-heat themselves in the field, and die in six days with a bilious fever, their bodies as yellow as saffron. This is a yellow fever of a mild kind, generated in the system by the debility occasioned by excessive heat and fatigue, without any external cause. Thus the extreme heat of August and September 1793 will alone account for the unusual violence and extent of the pestilential fever of that year.

In the warm season, and especially in the time of epidemic fevers, people should be doubly cautious not to expose their health by excessive fatigue. Labour should not be violent, and walking moderate. In extreme heat the natural excitement of the system is usually too great; a small addition of it thaws the body into a state of debility which invites disease. Not only health, but life is often suspended on the point of half an hour's exercise. Temperance in labour,
bodily

bodily and mental, is as essential to good health, as in eating or drinking. The muscles and the nerves, those moving powers of the human body, if stimulated beyond a certain point, lose their excitability, beyond the possibility of a recovery.

The danger incurred by sedentary and studious men, during pestilence, from the debilitating effects of their occupations, is greatly increased. Want of due exercise is directly relaxing to the solids; while application of the mind is apt to over-excite the nerves and induce indirect debility. The extreme irritability of the nervous system is obvious in a pestilential state of air—I experienced it most sensibly in the summer of 1795, during the fever in New-York; and it is evidenced in the vertigo, so frequent at such times; in the seizure of many persons in the plague with apoplectic symptoms; and in the palsies and apoplexies which are greatly multiplied before or after the prevalence of a pestilence, and which in some places have become almost epidemic.

During the rage of epidemic pestilence also the animal appetite should be indulged with moderation—excessive indulgence, which might have been sustained at other times, has oftentimes hurried the young and sprightly to a premature grave. Nothing can be more dangerous; according to all medical writers on this subject.

Celsus directs that in pestilence, persons should seek fresh air, travel, sail; or if these are not
con-

convenient, they should avoid fatigue, indigestion, cold, heat, excessive indulgence of the animal desires; especially, says the Author, in a pestilence which is occasioned by southerly winds.

Vol. i. 40. 41.

These observations are not new; they are common and well known to medical men, and to all others of discernment. They are here inserted, because they may be in this work more generally read than in medical books, which are opened only by professional men.

But all these rules, if strictly observed, will not, in a more violent plague, be sufficient to secure the body from attack. Such are the extremely debilitating qualities of the air, in some periods, that it will be necessary to counteract them by artificial powers positively tonic.

The application for this purpose which is most easy and effectual, is *water*; an article which nature has furnished in the greatest abundance, because it is far the most useful. On this subject, perhaps, the following ideas may not be common.

My attention to water, as a prevention of pestilence, was first excited by a passage in Volney's Travels in Egypt and Syria, chap. xvii. where he informs in a note, that "At Cairo, it is observed, the water carriers, continually wet with the fresh water they carry in skins upon their backs, are
never

never subject to the plague."---The author is there speaking of the pernicious effects of humidity on health; but the escape of the water-carriers he ascribes to *lotion*, whose effects are different from those of moisture by vapour.

If this fact is accurately stated it is worth an empire. I am inclined to believe it, and to ascribe the escape of these men to the constant application of water to their bodies, during the labours of the day. Yet, if true, why have not authors propagated the knowledge of so important a truth to every part of the world? Is this neglect also the fruit of the pernicious errors respecting the exclusive origin of the plague from infection? The calamities sustained by mankind in consequence of those errors exceed all calculation.

How is it possible, that, if a remedy for the calamity of pestilence is so obvious and near at hand, the Egyptians should not have applied it universally? Can this be ascribed to the doctrine of predestination, which makes them careless of the means of prevention?

It is very certain that the laws of Moses, respecting the prohibition of blood, fat, swine's flesh, and certain other animals; as also the whole system of ablutions, purifications, and use of perfumes, was intended to correct the evils of the climate; and many of his directions became totally useless when the Israelites left that country
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and its vicinity. Heaven never could intend some of the provisions of the Mosaic code for more temperate and healthy climates.

The ancient Egyptians had similar practices, and probably long before the days of Moses. Their laws and customs to ensure cleanliness were very strict, and they involved a most liberal use of water. Herodotus expressly declares, that "they scour their cups, wash their linen, and *circumcise for the sake of cleanliness*. The priests bathe twice by day and twice by night, and are obliged to wear linen." Swine's flesh was also considered to be unclean and prohibited as an article of food.

See Book ii. Enterpe.

These regulations, doubtless, proceeded from the experience of their good effects. It is not improbable that the introduction of the Mahometan religion, may have been accompanied with the abolition or disuse of ancient practices, which were friendly to health. Certain it is, that the oriental nations make great use of baths, the original design of which was probably to guard against diseases, but which have been abused and converted to the purposes of luxury.

Let us then pursue the idea of applying water as a panoply against the attacks of pestilence. By what means does water guard the body from that disease?

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I have already quoted the observation of Dr. Priestley, to prove that water absorbs the septic acid. If this opinion is well founded, and I have no doubt of it, we have obtained a most essential *item* of knowledge. Fresh water frequently applied to the body receives and carries off all the matter of infection, thus removing *one* copious source of the disease.

Savary remarks, that pestiferous matter passed through water will not communicate the distemper. This is a confirmation of Dr. Priestley's principle.

The cessation of the plague in Egypt, on the inundation of the Nile, is no small evidence of the same principle. The water changes the state of the air, both by absorption, that is, imbibing and carrying off the pestiferous sources of vapour from the earth, and by extricating a quantity of fresh air. And this important fact directs to the mode by which all great cities are to prevent or lessen the force of this disease. What the Nile does once a year for Egypt, fresh streams of water should do every day in the *hot season* for large towns, they should inundate the streets. Nature has given, in Egypt, the most ancient and most common nursery of the plague, the *model* of the best remedy for the severest calamity incident to man, a model which few cities have been wise enough to copy.

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But it will not be sufficient to trust wholly to the effect of a diffusion of water over a city. In the hot season, it should be applied to the body very frequently, in the way of lotion or bathing. By this I do not mean to recommend the practice of leaping into river or sea-water, and continuing in it for half an hour—a practice which proves fatal to many lives every summer. Cold water is the most powerfully debilitating application that can be made to the body. No person can bear it, even in summer, but the healthy and robust; and to save such from injury, it must not be applied when the body is over-heated, or continued too long. Many—many instances occur every year, in which a fatal yellow fever is speedily induced by injudicious plunging. An instantaneous application of cold water to the body, by a single plunge, or by a shower-bath, sometimes acts as a stimulant, by a sudden increase of excitability in the system; but this should be used as a remedy under the direction of a physician. Few persons can sustain the shock, unless in good health; and I am persuaded it would be as well for mankind if the use of cold water by plunging were wholly proscribed. Judiciously applied, it is sometimes useful; but my own observations lead me to believe the utility is more than over-balanced by its fatal or mischievous effects.

The most safe, easy, pleasant, and beneficial mode of using water, is, to bathe or wash the
body

body in a private apartment at home. This may be done in several ways—either in a large vessel, immersing the whole body at once; or, what is less troublesome, with a single pail or bowl of water, in a bed-chamber. The washing may be done with the hand, or a sponge, in a few minutes, as the person rises in the morning, or retires at night.

The temperature of the water should be near that of the blood; a little cooler, or a little warmer, and in such a temperature, it is a pleasant application, occasioning no violence to the system.

It may not be obvious to every common reader, that the application of warm water to the surface of the body, in a hot day, should cool it. But such is the fact; and nature points out this mode of reducing the heat of the body by the process of perspiration. In this process the insensible vapour which escapes by the perspiratory ducts, takes with it a portion of heat; and the more freely a person perspires, the more temperate the heat of his body. Hence the human body is enabled to sustain heat several degrees above that of the blood; and hence the flesh of a child in full health, perspiring freely, feels cooler than the air in a summer's day. This phenomenon may be illustrated by a thermometer, with the utmost ease. Immerse the bulb in warm water, in a hot day. Let the water be of 75 degrees of heat, and the air of 80°. The thermometer, standing at 75

in the water, and taken out into a warmer medium, the air ought to rise to 80°; but being wet, the evaporation will sink the mercury four or five degrees; that is, to about 70°, until the instrument is dry, when it will rise to 80°, the temperature of the air.

On this principle, warm water, as well as cool, will lessen the heat of the system; for no sooner does a person cease to apply the water, than evaporation commences, and cools the body by several degrees. This effect, however, is temporary, in consequence of the stimulus of the heat.

In very hot weather it is better, especially for persons in the vigour of health, to use water a little cooler than the blood; for the effect of warm water, applied in the manner proposed, is to stimulate; and this is not what the body requires. On the contrary, when highly excited by the heat of air, the body requires a reduction of heat, to prevent over-excitement, and its effect, indirect debility. In general, then, the body in summer is to be cooled by the use of water while in a healthy state; but if debility or disease has invaded it, it requires heat and excitement.

Persons of a *slender habit*, who require additional stimulus, should use water a little warmer than the blood. The effect of cool water applied to persons in full health, and of warm water to feeble

feeble habits, is the same, to *prevent debility*; *indirect* in the former case, and *direct* in the latter.

Bathing a long time in very warm water, to produce profuse perspiration, is a powerful laxative; and perhaps it would be better if it was never used, except as a remedy for disease under the direction of physicians.

The beneficial effects of the use of water in pestilence, therefore, are these:—The poisonous particles composing infection, and exhalations of all kinds, are washed from the body, and their ill effects prevented. The morbid matter exhaled from the body by the perspiratory vessels, is also removed—an effect which may be aided by frequent changes of clean linen. The extreme vessels are stimulated and cleansed, by which means they are enabled to carry on more perfectly the excretions; perspiration being one of the principal resources of nature to expel the poison which enkindles the flame of pestilence.—The whole system is kept in equilibrio, by a diminution of excitement in the robust, and by an increase of it in the debilitated; the consequence is, the system is daily renewing its tone and vigour, the energy of the brain is preserved, the muscular fibres retain their powers, and all the functions of the body, the digestion, circulation, secretions, and evacuations, are regularly performed.

Medical gentlemen will excuse me for these ideas, which belong more properly to their province. They are not new to that description of citizens; but, if just, they ought to be universally known; for they lay the best foundation for a regular plan of economy in domestic life, which will greatly alleviate the distresses of autumnal epidemics. I cannot help thinking mankind are yet in their infancy in this respect; and that in general they understand the true art of living, which shall secure health and happiness, as little as they understood agriculture, or naval architecture, in the days of Henry the First.

I am persuaded that the whole art of securing ourselves from pestilence, as I have before remarked, consists in this single maxim—"Preserve the natural energy of the system." That water, fresh and pure, is the instrument most efficacious for this purpose, I must believe, from reason and experiment. The fact related by Volney of the escape of the water-carriers, is of infinite weight, if fairly stated, and demands immediate application to our own case. At any rate, it demands investigation.

I have other proof of the success of water, used as I have prescribed. A friend of mine who has lived many years in the West Indies, who has seen the yellow fever in all its forms, who has tended the sick in that climate and in New York, exposed himself to their breath and effluvia for days and nights,

nights, and slept with his own son when on his death-bed with that disease, has hitherto escaped the infection. He ascribes this impunity to a daily use of water in the manner above mentioned.

We are not to calculate on the universal and invariable success of any remedy for this terrible calamity. Multitudes of men will not take the pains to use the means necessary to resist the effects of the numerous causes of disease which surround them. They will neither regulate their diet, nor cleanse their persons and habitations; and when to the influence of their own intemperance, and the poison generated in their houses and on their bodies, is added the debilitating operation of peculiar seasons, and other causes which are above human controul, great numbers of them must sink and perish.

Nor is it to be supposed that any human means can, in every case, guard life, in a pestilential state of air. If we admit *debility* to be the universal proximate cause of the plague, we are not sure that our best efforts to obviate its effects will always succeed. We may not be able to find or to apply, in all cases and under all circumstances, the precise degree of stimulus necessary to preserve the corporeal functions; and the variety of constitutions, and diverse operations of the same remedies on different bodies, will defeat, in some

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cases, the most exact application of the best possible system.

Of one thing I am confident, that, in our cities, as now constructed, no rigours of police can so effectually cleanse away the sources of poison, as to prevent a return of pestilence, without the universal introduction of a new domestic economy, and new modes of living. I am firmly persuaded that fruitful sources of the evil lie in these two articles—the excessive use of stimulant food and liquors, and the neglect of personal washing. The diet of the Americans, like that of the English, is of the most nourishing kind—a large portion of the best flesh meats, and high-seasoned fish and vegetables. Our drink is of the same character—the best high wines, spirits, and brandy.

In winter our bodies sustain this stimulant mode of living; the extreme cold continually resisting its effects by its debilitating powers. But when summer arrives, and the violent stimulus of heat is added to the high stimulus of the best diet, two classes of men fall a sacrifice to violent fevers. First, men who push their stimulus beyond the powers of nature, by excessive exertion and intemperance in eating and drinking. Hence a robust man riots in debauchery to-day, and four days after is in his grave. Secondly, men who live freely in winter and reduce their

diet too low in the summer, to avoid diseases, inducing a weak, languid state of the system.

It must be obvious to any person in America, that the French mode of living, in regard to diet, drink, and the liberal use of water and the syringe, protects them from the epidemic diseases which prey upon the Americans and British natives. Nor have I the least doubt that a suitable regimen, pursued rigorously by the Europeans, would have saved one half of the people who perished in the black pestilence in 1348.

Unfortunate souls ! they believed the plague to be communicated by infection only ; they sought safety by flight ; they embarked on board of vessels, and launched out upon the ocean to *escape infection* ; but all in vain : the disease attacked them in every situation, and the world was almost dispeopled. Had they known that the distemper was induced solely by the debilitating qualities of the elements and the season, what multitudes would have applied the true remedy and survived ! Thanks to a kind Providence, such a singularly distressing state of the air occurs scarcely in a century ; but when it does, there is no flight from the sources of disease, as in ordinary plagues, which arise in the impure atmosphere of cities only ; but men must have recourse to the applications which resist the effects of debility, and maintain the energy of the system

by supplying the defective powers of the elements with artificial stimuli.

I cannot close this section without a few remarks on the general plan of building large towns.

The ancient mode of constructing cities bears some characteristics of the age and taste of the nations in which they were respectively founded. Most of the old cities were evidently built with reference to a state of war and robbery, being intended for safety rather than for convenience; as appears by their narrow streets, and the projections of the upper stories of the houses. The more people could be crowded into a small space, the less military force was necessary to defend the town.

However this may be, those cities were very ill constructed for the purposes of health. Savary asserts, that 200 persons in Grand Cairo occupy less space than thirty in Paris. The streets are so narrow and full of people, that they jostle against each other, and sometimes a man is obliged to wait some minutes before he can make his way, Letter iii. Yet this same author alleges the plague to be *not native* in Egypt! Surely a man of science need not go out of Cairo to look for causes of pestilence.

Many streets in Constantinople are narrow and crowded like those in Cairo.

The old city of London, before the *fortunate* conflagration of 1666, was in a like predicament; its

its streets narrow, and almost closed above by the jutting of the upper stories of the houses. In the old streets, which escaped the fire, notwithstanding all the improvements of modern days, which have mitigated the violence of pestilential diseases, I am informed people are still infested with nervous and typhus fevers. London is however greatly indebted to the conflagration. In the present construction of the buildings, *one* person, it is said, occupies as much ground as two did before the fire. The size and arrangement of houses and apartments are also improved, and better adapted to a free circulation of air. The introduction of fresh water may also be numbered amongst the best preservatives from disease. These are among the causes of the non-appearance of the plague in modern London; and the diminution of the annual bills of mortality within the last half century.

The plague has however disappeared in other cities of Europe, where no such improvements have been made—a curious fact that will hereafter be considered.

But the disease continues to prevail occasionally in the eastern parts of Europe, in Hungary, Poland, and Russia, which were severely ravaged in 1770 and 1771. The disease also raged at Ocza-kow, on the north border of the Euxine, as late as the year 1739.

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That part of Europe abounds with marshes and stagnant water, and consists mostly of level land. This may account for the continuance of the plague in that quarter.

The United States unfortunately contain similar sources of disease, in number and extent scarcely equalled. Yet, instead of profiting by severe distresses, which all great cities have suffered once in fifteen or twenty years from pestilence, and guarding against the artificial causes of it, our ancestors began, and we are continuing, to build cities on the Gothic plan, without more regard to the lives and happiness of our citizens, than that which was manifested by the barbarians of antiquity: the moderns, however, proceed on the same plan, from a different motive, which is avarice. It is now the interest of the proprietors of lots in a city to which all the pleasure of living, and the health of citizens, are sacrificed.

We are precisely in the latitudes most favourable to the production of pestilence. In the tropical climates, constant heat soon fits the human body to sustain it, and the *natives* of those climates are seldom affected by the furious rage of epidemic pestilential diseases. Within the tropics *strangers* alone are sufferers by the climate*.

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* Savary remarks, "That the plague seldom reaches the polar circle, and never passes the tropics. The caravans of Cairo, Damascus, and Ispahan, which are sometimes infected,

But in the temperate latitudes, men are continually subject to the alternations of extreme heat and cold—changes hostile to the system.—In winter, we may be said to be inhabitants of Lapland; in summer, of Mexico, or the West Indies. If we do not remove to the polar circles, or to the tropics, yet the revolutions of the seasons *bring their climates to us*—and we annually run a similar risk with the Europeans, who pass from the northern to the southern latitudes, and perish in multitudes.

It is a most unquestionable fact, that the northern States of America, from New York to Maine, are in a position on the globe as exposed to the plague as the cities of Marseilles, Naples, Rome, and Constantinople; and the southern States have a position corresponding with the latitude of Syria, the Barbary coast, and Egypt; that portion of the earth which is *most frequently* ravaged with pestilential diseases.

fects, never propagate it at Mecca, and Yemen is safe from the plague." With few exceptions these observations are just. If the natives of cool regions pass suddenly into tropical climates, they are subject to violent fevers; but the reason assigned in the text is sufficient to account for the perpetual exemption of *natives* of hot climates from the worst form of pestilence. Their bodies mould themselves to the climate—their excitement or debility is always uniform. It is the great changes, in these respects, which expose people in the middle latitudes to the attacks of pestilential diseases.

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If then we live in a climate in which the human body, from alternate heat and cold, is most irritable, and most subject to malignant autumnal distempers; and if a part of our country is peculiarly adapted to the production of such diseases, the most serious of all questions arises, what shall we do to prevent a frequent return of such calamities?

To me the path is extremely plain. Our climate we cannot change—much of our country cannot be raised into hills, nor drained of its stagnant waters—the laws of nature we are unable to controul in their operation.—But our duty is plain.—Men must not plant their habitations near marshy grounds—the mode of building cities *must* be totally changed—and so must the usual habits of our citizens.

Throughout the whole Atlantic territory, on the low lands, it is more essential that large towns should be purposely constructed for health.—Great cities are usually founded on commerce, and commerce requires the access of navigable water. Hence such towns are commonly near the sea shore, or on the borders of rivers.—But if they are near low marshy grounds, they cannot be healthy. High and dry positions, with rocky or gravelly earth, are the proper places for populous cities, on account of fresh air and good water.

But in any situation our cities are too crowded for health or comfort. Lots are too small.—Too many

many people are crowded on too little a space of ground. A family to every lot of 25 or 30 feet by 80 or 100, cannot fail to generate too much filth, and to vitiate the air in too great a degree for the health of the citizens. In every large town in the United States, however remote from marsh, and however healthy its position, the effects of crowded population are obvious every autumn in the sickness and death of *children*. Multitudes, and multitudes of lives are annually sacrificed in all cities to the avarice of the original proprietors of lots. The little, narrow, dirty houses, kitchens and yards, surrounded with high fences excluding air and vegetation; all that can dissipate or absorb the noxious exhalations; all that can purify the atmosphere, and refresh the exhausted frame of a human being panting beneath a sultry sun. Every thing in our cities is contrived to *waste the powers of life and shorten its duration*.

Men, in this respect, are infinitely less sagacious than irrational animals.—Instinct guides the beasts of the field to the most proper habitations, and they never reside where they are *annoyed*. But man, with all his boasted reason, sees the effects of his folly, and hundreds and thousands of his fellow-citizens falling victims to his own neglect, his mistakes, or his sordid principles: he heaves a sigh in August and September as he views the sable hearse conveying his friends, in scores, to their graves: in November he shrugs his shoulders,

ders, and says, *it is all over*; runs to the circus, the theatre and card-room; laughs away the winter's evening with his jovial companions, some of whom are destined, the next season, to fall a sacrifice to the same folly and neglect, and to fill new ranges of graves by the side of the victims of the preceding year.

In the United States, every thing that has been done hitherto in the construction of cities, is in imitation of the old European and African mode, and of course is wrong.

The ancient construction of London cost that city nearly *two hundred thousand lives* in one century; and Cairo and Constantinople, probably lose more than that number every half century. I firmly believe, and my belief is founded on the uniform operation of established laws of nature, that *a perseverance in our present mode of building cities will doom them all to the same fate*.—I believe it, because I see no possible reason why pestilential diseases should not be as frequent and as fatal in America as in the old World, under the operation of similar local causes.

If a rigid policy can be uniformly observed, and every possible nuisance be removed by shovels, brooms, and water, cities, in healthy positions, will escape the regular and constant return of malignant epidemics. Multitudes of lives may be saved, and the loss of business prevented by these means: and in cities already built, cleaning, washing,

washing, and purifying, are the guardian angels of public health.

But, I maintain, that this is not exterminating the root of the evil.—Cities *may* be built so as to unite all the utility of a town with the salubrity and pleasures of the country; and in this new world, where men are as free to act as to think, it will be dishonourable not to invent and execute a plan for these purposes.

Were I called on for a plan of a city which should combine in it the advantages of town and country, I should suggest the following as the outline:

1. The position to be on the shore of the sea, or the bank of a river, gently ascending with an angle at least of fifteen or twenty degrees, which would form a declivity for a rapid descent of water to wash the city, at the same time would not prevent the draft of heavy loads from the river or ocean.

2. The wharfs on the water should be extended beyond low water mark, that no part of the docks should be left bare by the recess of the tide. All the solid front of the wharfs should be in a line that no eddies might be formed, and the water might flow in a passing current. This would carry off substances thrown into the water, and contribute to keep the air pure by motion and change. Should it be necessary to extend wharfing

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in one place further than in another, it should be in the form of a bridge on piers.

3. The warehouses on the wharfs should not be jumbled together in a chaos projecting in front of one another; but built in a strait range at a suitable distance from the water; and an alley should pass between them for the admission of fresh air on every side. No wet cellars should be permitted.

4. The streets should be strait, intersecting each other at right angles, and forming the city into squares of 500 feet on a side.

5. The lot should be at least 60 feet wide, and 250 feet long. No more than 35, or, at most, 40 feet of the breadth of the lot to be ever covered with buildings, so that a space of 20 or 25 feet should intervene between the houses. This space would leave a cartway, give free admission to air, and reduce the risk of fire 75 per cent.

6. In the rear of the front building out-houses might cover 100 feet of the length of the lot: the remaining 150 feet should be laid out to the fancy of the owner in a garden.—The police interfering no farther than to require, by law, that some kind of trees or vegetables should occupy the space,—vegetation being the natural purifier of the air.

7. Directly through the centre of each square should run a narrow street of about 25 feet, taken out of the rear of the lots, which street or alley should

should never be built on, but would admit a passage for citizens through the squares, and what would be still more necessary and useful, would admit dust carts to take up all the filth of the houses from the rear, and prevent that intolerable nuisance, the depositing of offensive materials in the streets. The little flower gardens and shady lawns in these squares would preserve the air pure, fresh, and cool in summer; they would occupy many persons of delicate health, thus contributing to their comfort, diverting their minds, and, in many cases, restoring them to health. Here, also, children would find room to gambol without endangering their lives, or annoying passengers in the streets; and here the young of both sexes could acquire a taste for gardening, for botany, and the delightful amusement of studying the works of nature.

8. The streets should be 100 feet in breadth, and planted with three rows of trees; one row on each side next the foot walks, and a row in the centre.—The foot walks to be 15 feet wide; the trees next the walks would then be 15 feet from the houses, and a space between the centre row and each side row of 35 feet. The trees might be so pruned as to prevent their injuring the buildings, and their distance would prevent their interfering with fire-engines: these trees would be leafless in winter when the sun is acceptable, and in summer would sweeten, purify and cool the

air. The citizens at all times in the day would walk in a refreshing shade.—The centre row of trees would furnish shade for horses.

9. No city should be raised on level earth. If a natural position can be found, with a general declivity to the water, the streets should be thrown into artificial elevations of, at least, three feet in every hundred,—five feet in the hundred would be better:—this would give celerity to the water falling in showers, and wonderfully assist in removing filthy substances from the streets; for after all human efforts in sweeping, much offensive matter will remain, which water alone will reach and carry off.

10. No pains should be spared to supply a city with fresh running water.

It is a point of infinite importance, that citizens should not depend on water from pumps in the city. In a few years the subterranean water becomes impregnated with the noxious particles from vaults, and this evil continues to increase with the age of the city. One of two remedies is to be provided—either the city must be supplied with fresh water by pipes from a distant source, or the vaults must be so formed as to be capable of being opened in winter and cleansed. But the last method, though useful and practised in some European cities, would be ineffectual.

The back houses in a city are, in many respects, a terrible nuisance. If a sewer could be carried

four or five feet under ground, and every such house set over it, a stream of water passing through it from a distant source would be an excellent means of cleansing a city from this source of disease: but such streams of water are rarely to be obtained.—Another expedient suggests itself for the same purpose:—Let a sewer of three feet wide, and well paved, be run in a straight line under the rear of the lots, and all back houses set over it. In suitable places let channels be made to turn the water from the streets into the sewers, in long or violent showers, when the water is not wanted to wash the streets. In this manner the sewers might be washed perfectly clean a number of times every summer, and the citizens preserved from their poisonous exhalations.

On a model of this kind, I conceive cities should be constructed in the *most healthy* situations, for a crowded population in any place on earth will lessen the salubrity of the air. Close, compact cities, in any quarter of the globe, are the graves of men. All the great cities of Europe require annually some thousands of strangers to supply their waste of population: yet there is no necessity for men to crowd together in such a compact form. There is land enough on earth to suffer any extension of cities, and it makes little difference, in the first instance, whether a lot contains one hundred feet of land or half an acre: nor would a less dense population be any inconvenience

venience to men in business: they might be obliged to walk further on some occasions, but in the cool shade of my proposed city this would be a pleasure rather than a toil.

It is wrong, it is criminal, for legislatures to permit such crowded population. It is a nuisance, not only to cities, but to the public.—It is a truth, that numbers of lives are sacrificed almost every year among worthy country gentlemen, who have business in our large cities.

They come to town in the hot season, when no uncommon disease prevails among the citizens who are inured to the air:—they come without suspicion:—they are seized with fever, and die. The air of the low grounds in our cities, even in healthy seasons, is often poison to the people in the country, and gives them a fever when no epidemic is visible among the citizens.—I know the fact, and it is a serious calamity, especially to seamen. The low grounds in Providence, New-York, Baltimore, &c. are great nuisances.—The building of Water-street and Front-street, in New-York, it is believed by good judges, has cost this city a thousand lives in five or six years.—I say nothing of Philadelphia, for its position, and the alterations in the original plan of the city have doomed it to calamity.—The citizens will not believe the evil to arise among themselves, and therefore must be left to their fate.—If remitting fevers every year, and yellow fever often, will not convince

convince men that something is wrong in *their* city, it is in vain to reason with them.—Of one thing I am confident, that if all the earth in New-York on which Water and Front streets are built, could be sunk 30 feet under water without loss of lives, and the proprietors indemnified by the citizens, it would be the greatest blessing which heaven could in mercy bestow on the city and the State. I believe, also, that if all the cross streets, and the back houses in Philadelphia could be levelled with the earth, and the ground converted into flower gardens and grass plats, the citizens would, in twenty years, celebrate the anniversary of their destruction with as much fervour as the republicans in France celebrate the demolition of the Bastile.

It is not possible, I speak in zeal and confidence, it is not possible, under the operation of the *present* laws of nature, for men to be healthy in many of our cities during the heat of summer. That open champaign country, which regularly produces intermitting and remitting fevers, will, when planted with populous cities, often produce the plague. Of that country there is an extent in the United States, of more than 1000 miles in length, and from 40 to 60 in breadth.

All the shore of the Atlantic, from the Hudson north-eastward, will admit of healthy cities. If the commercial towns on that portion of America were constructed on the foregoing plan, I would answer

for it, that they would never be ravaged with yellow fever: Individual cases might occur, but the disease could not, without a miracle, become epidemic. But as our towns are now built, they will at times be partially affected. In *ordinary* seasons, and with a vigilant police, they will escape with the yearly loss of only ten, fifteen, or, perhaps, fifty citizens, the unfortunate victims of the negligence, the folly, and the crowded population of cities. In very *unfavourable seasons* the number of victims will be *increased*.—*Such is the fate of our northern cities*.—But the destiny of cities on the southern Atlantic shore is to be more severe.

The period of general contagion may subside, and intervals of more general public health, may be expected. The most unhealthy parts of the earth enjoy such intervals, when the rage of malignant complaints is suspended; but melancholy periods of epidemics will often recur—and as the plague, in all its shapes, is the offspring of *causes*, mankind, wherever those causes exist, are destined to be afflicted.

Away then with crowded cities—the thirty feet lots and alleys—the artificial reservoirs of filth—the hot-beds of atmospheric poison. Such are our cities—they are great prisons, built with immense labour to breed infection and hurry mankind prematurely to the grave.

There is no necessity for this destruction of human life. Cities laid out on my plan would

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unite all the pleasures of country villages, rural seats, and commercial towns. The merchant, in his ordinary business, would enjoy the grateful shade of oaks and elms, with the luxuriant perfumes of odoriferous flowers. At the same time, this verdant city would supersede the use of solitary country-seats in summer, and thus save the expence now incurred of possessing a town and country house. The country seat of a merchant, is a tax of ten, fifteen, or twenty thousand dollars, paid to maintain the poison and pestilence of our present cities.

It is remarked by Boyle and other authors, that China is rarely affected with the plague. The pestilence of 1347 is said to have commenced in that country; but it seems to be agreed, that China and some other Asiatic countries are not often affected. This fact, if just, deserves investigation; in particular, ought philosophers to examine the nature and properties of the soil, and the mineral productions.

China is a very populous country, filled with canals, and well cultivated. It is probable that the water in their canals is never stagnant, nor filled with vegetables—it is probable that the face of the country has been completely dried by cultivation, all swamps and moist grounds drained and covered with corn, rice, and grass. How much these improvements have contributed to preserve

preserve its inhabitants from pestilence, I need not inform my readers.

The cities also in China are vastly large and populous; and an enquiry will arise, how those cities escape the plague, if great population contributes so much to the calamity.

I answer, they do not escape all plagues—some of the most violent have ravaged China, but they probably escape the slighter plagues, which are the most frequent; and this is all that mankind can expect.

We are not sufficiently acquainted with the soil, climate, police, and manners of China, to speak with certainty on the subject; but one fact ought to be mentioned. The Chinese houses have no windows in front on the street, but in the rear, are spacious gardens filled with trees, vegetables, flowers and fresh streams of water. Here the family is regaled and amused; the air is rendered pure by cultivation, cleanliness, and the particles exhaled from growing plants, and waterfalls. This arrangement alone will account for their exemption from the usual diseases of hot climates. When the Americans, with their boasted light and science, shall become as wise as the Chinese, they may expect to share in the exemption.

It is a fact related by Ruffel and others, that in the midst of the Turkish cities, during a desolating plague, the spacious mansions of the

wealthy Turks, which are kept clean and well aired, often escape the disease.

I cannot leave this deeply interesting subject, without relating an anecdote from antiquity, which shews in what light wise men formerly viewed it.

In Greece the countries of Attica and Lacedemon consist of dry, gravelly or rocky land; and I can find but one instance in which they were afflicted by pestilence, in early ages. It is evident from Thucydides, that the plague had never been known in Athens, before his time, since the date of the earliest traditions, and then it was probably induced principally by the crowd of people collected in the siege, to escape the ravages of the Lacedemonians.

Beotia, on the contrary, was more frequently visited by pestilence. To account for this, let us know what was the situation of this country—it is thus described :

Beotia may be considered as a large basin, surrounded by mountains, the different chains of which are connected by high grounds. Most of the rivers from these hills unite in lake Copais, of fourteen leagues circumference, which has no apparent outlet, but which, it was alleged by the ancients, had subterranean passages to the sea.—The country is not without hills; but is mostly level, and very fruitful. The air in Attica is remarkably pure; but in Beotia, very dense; hence the

the ancients derived the heavy phlegmatic character of the inhabitants from the air. This country seems to have been to Attica what Holland now is to France.

See Travels of Anacharsis, ch. 34, and the authorities there cited.

From several passages of History, it appears that Beotia was more frequently visited by pestilence, than Attica—this we should expect from the difference of their situations.

Justin, lib. 16. ca. 3. informs us, that the Beotians once consulted the Delphic Oracle how to remedy the plague which troubled their country. The Oracle replied, “that they must plant a colony in the country of Pontus, sacred to Hercules;”—but they were so much attached to their own country, that they disobeyed the injunction; until another calamity, war, drove them to consult the Oracle a second time, when, receiving a similar answer, a part of the people removed to the borders of the Euxine, and planted the famous city of Herculeia.

This Oracle certainly understood the cause of the evil, and directed to a suitable remedy. The answer implies, “you must thin your population—” or “you must seek a more salubrious climate;” or it might include both of these ideas. The direction is full of wisdom, and is strictly applicable to many of our American cities. Translated into

the language of our circumstances, it runs thus :
 “ Thin your population, by spreading your citizens over a larger extent of ground, or you must be driven from your cities, or you must perish by the plague.”

We have “ Moses and the prophets” in books and experience, and if we will not listen to them, neither the Delphic Oracle, nor a messenger from the thousands of dead who have perished by the plagues of our cities, would induce belief or effect a reformation.

SECTION XVIII.

Of the Disappearance of the Plague in some Parts of Europe, and of new Diseases.

IT is a common remark, that no plague has appeared in England since the year 1665, and that the disorder has ceased in the west of Europe for near a century past. This happy exemption from that horrible calamity has been ascribed to various causes. Many people ascribe it to health-laws, a subject that has been discussed. Some allege that the use of fossil coal has banished the plague from London; and Hoffman relates, that Halle, in Germany, which used to be afflicted with malignant fevers, has been free from them since coal has been used as fuel. Others suppose, that the great improvements in building and in the modes of living, in modern times, have been the means of preventing the return of pestilence.

On the first cause I have already given my opinion, and the reasons on which it is founded. I find no sufficient evidence that health-laws ever saved a country or city from pestilence, in a single instance, but abundant positive proof of their utter inefficacy in a great number of cases.

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With respect to the use of coal, we ought not to indulge very sanguine expectations. It may be true, that violent diseases became more rare, or wholly disappeared, in some places, about the time that coal became of general use as fuel. But let us examine facts, and not trust to general cursory observations.

The digging of coal, at Newcastle, for fuel, commenced as early as the year 1234, as appears by a charter of Henry III. and how much earlier is not known. It was used in London as early as 1379, in considerable quantities, but when first introduced does not appear. In 1550 coal was in common use in London, its price "twelve shillings a load." The price in 1590 was raised to "nine shillings a chaldron," which was deemed exorbitant. Thus far we have little light on the subject; but in 1615, the coal trade occupied four hundred ships; *two hundred* of which were employed between London and Newcastle. The present number is *five hundred*, and London contains more than double the inhabitants it did at that time.

See Anderson's Com. vol. i. and Fleetwood's Chron.

In 1615, then, the use of coal must have been general in London, and for some time before, for the growth of the trade must have been gradual. But for fifty years, after this general use of coal, London was afflicted with the plague; the city
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indeed was rarely free from it, as appears by the Bills of Mortality; and three times after that period the city was ravaged by that distemper, as an epidemic, viz. in 1625, 1636, and 1665.

So far we have no encouragement to hope for a prevention of the plague by the use of coal. With respect to the city of Halle I can say nothing. The observation of Hoffman may be just; yet coal may have had no influence in checking the prevalence of pestilence.

It belongs to physicians to ascertain the effect of the vapour from this fossil substance on human health; certain it is, that it occasions inconveniences to those who are not accustomed to it. So general was the prejudice against it, when first used in London, that in the year 1400, the nobility and citizens petitioned the King "to prohibit the further use of so noxious and unhealthy a kind of fuel."

And. Com. vol. 6, ap. 935.

There is reason to believe it is not very unhealthy, but I see no ground to suppose it has had the least influence in arresting the progress, or preventing the return of the plague.

To confirm this opinion, I would mention that the plague disappeared in France and other parts of Europe about the time it did in England; in Paris, for instance, where no coal is used. In a great part of Europe therefore
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the same effect has taken place without the supposed cause, which leaves us at liberty to reject that cause.

The third reason assigned for the cessation of the plague, viz. improvements in building houses and cities, and in clothing, diet, the use of fresh water, and the like, is a just one; and there can be no rational doubt that these alterations have contributed to mitigate the violence and restrain the progress of many acute diseases. Pestilential epidemics are probably less frequent within the last century, at least in the more civilized and commercial parts of Europe, and also in America, than they had been in former periods.

The poverty, the filth, the dirty crowded mud cottages, and the scanty supply of wholesome food, which was the common fare of the peasantry in Europe, must have given origin or currency to many diseases, and greatly aggravated their severity. A sample of this may be seen in the early appearance of mortal *diseases* in the low narrow streets and small crowded apartments, now occupied by the poorer people in our cities, and the difficulty of expelling a pestilential disease from such places.*

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* The following extracts will show the state of cities and the manners at the periods mentioned:

“Westminster and London were once above a mile asunder. The Union with Scotland, in 1603, did not a

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As a general remark, it may be alleged, with great probability that Europe has derived no small benefit, in regard to public health, from the following circumstances.

First, From the modern improvements in agriculture, by which means many places are dried and sweetened which used to be cold, damp, and fetid.

Agriculture not only removes from the earth substances positively noxious to health, but covers its surface with growing vegetables positively salubrious. This is one instance, of multitudes in the oeconomy of the world, in which

little conduce to make a union of London and Westminster; for the Scots greatly multiplying here, *nestled themselves about the Court*, so that the Strand, from *the mud walls and thatched houses*, acquired that perfection of buildings it now possesses."

And. Com. vol. ii. 285. from Howel.

Voltaire says, about the year 1500, "Industry had not yet changed those *huts of wood and plaister*, of which Paris was composed, into sumptuous palaces. London was still worse built, and Peers of the realm carried their wives behind them on horseback."

In 1504, when James IV. of Scotland was married to Margaret, daughter of Henry VII. of England, the Princess made her public entry into Edinburgh riding behind King James on a pillion.

Henry's Hist. Britain, vol. vi. 597.

This princely custom is still preserved in New England, where the common farmers live in better houses than many of the nobles at the period above named.

which the happiness, comfort, and interest of man are made to depend on his industry.

See Dr. Rush's Works, vol. i. p. 25.

Secondly, Improvements in building houses may have contributed to the same salutary end. The materials are of a kind less susceptible of accumulating and retaining infectious exhalations than formerly; and the apartments are more spacious, elevated and airy.

Thirdly, Houses are less crowded than in ancient times, as appears by the proclamation of Queen Elizabeth, recited in the foregoing history. In London one person, since the fire of 1666, is supposed to occupy as much space as two in the old city. This remark applies especially to the poor, who were formerly more numerous than at present. Some of the nobles in the old city had spacious gardens; but the mass of people were universally poor, and crowded into narrow filthy lodgings.

Fourthly, There is probably an immense difference, in regard to general cleanliness, between the people even of the sixteenth century and the present age. For this we are partly indebted to commerce, the source of wealth and refinement. A more general use of linen and cotton in clothing, articles which require washing frequently, may have contributed to the same effect.

Fifthly, The introduction of pure water into cities from distant sources, and a liberal use of it in houses and the streets, have aided in the same salutary work of diminishing the calamities of disease.

Sixthly, it is believed that the modern diet is more friendly to health than that of former times. It is evident, that to this change Europe is much indebted for the disappearance of scorbutic complaints, which formerly were epidemic in Holland and other parts; and which still prevail in Iceland and Canada, where the poor live mostly on dried or salted fish, poor flesh meats, with a small portion of vegetables. The cultivation of the vine and the orchard has, doubtless, had a considerable effect. Cyder and wine have assisted in preserving the body from debility in certain pestilential periods; and when temperately used are of excellent use.

But while I admit that the true plague has disappeared as an epidemic in many parts of Europe, I do not admit that *pestilence*, in the general sense of the word, has wholly disappeared. If the true plague, technically so called, should never again occur in London or Paris, I should then say, that improvements in modern times may have *mitigated* the *pestilence*, but not that they have wholly banished it. Under this word *pestilence* I include small-pox, anginas, and petechial fever, with
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malignant disorders, which evidently depend on the same general cause as the real plague, operating in a different manner, or with less force. These diseases still appear in all parts of Europe, and exhibit the *existence of the pestilential principle*, although improvements may have *lessened* and *circumscribed* its effects.

I do not, however, consider it as certain, that the true plague will not revisit all the western parts of Europe. A concurrence of causes, like that in 1348, might again produce that disease in France, England, and Ireland, with all its horrors. But the probability is, that the modern improvements have removed so many of the *local causes* of disease, that no constitution of air will ever again produce the same mortality as that under Vortigern, or that under Edward III. nor will the plague ever again be so frequent as in former ages.

On this point, however, there is not sufficient ground to build any certain calculations, for the following reasons:—Every physician and historian well knows that there have been frequent revolutions or changes in the form of certain diseases; ordinary diseases with new symptoms, and diseases before unknown, have appeared in various countries, and in all periods.

The most remarkable of these are the small-pox, venereal disease, sweating sickness, Hungarian

garian fever, petechial and angina maligna, with some of less note.

I am not about to enter on the great question, when or how particular diseases have been introduced or modified in their symptoms. I suspect, however, there is a fallacy in the common theory about *new* diseases. What are usually called *new* are more probably nothing more than changes that are made in former diseases, by alterations in the atmosphere, climate, habits of living, and a multitude of inferior causes. The small-pox and the venereal disease seem to have the best claim to the appellation of *new*; yet the fact of their being unknown before the periods assigned for their appearance, has been justly called in question.

See note at the end of this section.

Certain diseases, however, appear in particular countries, where they had not before been known since the date of the earliest histories. Possibly some have been propagated by infection; others have evidently arisen from some general cause. Thus Pliny relates that the Elephantiasis was brought from Egypt into Italy by Pompey's troops, but soon disappeared. It is said also, that the same disease was propagated in the West of Europe by the Crusaders. Epidemic scurvy appeared in the maritime parts of Holland in

1556. The petechial fever which desolated Spain in 1557, and afterwards all Europe, was called a *new* disease, different from the usual purple fever said to be spread from the islands of the Levant through Italy to the West of Europe. The *angina maligna* in Spain in 1610, was called there a *new* disease; and in England, where it appeared about fifty years ago, it has been called a *new* disease in that country.

But the real state of the question seems to be epidemic diseases, most or all of which proceed from qualities of the air, suffer general changes in conformity with the revolutions and alterations which take place in the physical world. A remarkable instance of this was the *Sudor Anglicus*, which was, in its general symptoms, the plague; but some general cause in England first, and afterwards on the continent, superadded a peculiar symptom, that of profuse discharges by the pores. This character of the disease, as has been well observed by the author of *Traité de la peste*, was the effect of a species of revolution in the form of pestilence. Infection or contagion can have had no concern in producing this phenomenon. The disease maintained this peculiar character from 1483 to 1551, a period of almost seventy years, raging occasionally in most parts of Europe, and then disappeared; at least it has never made considerable ravages since that time.

This, in medical language, was a new disease, as demanding new modes of treatment; but, in the language of philosophy, it was only a varied form of the same malady, and proceeding from a common cause with the inguinal plague; but that cause, in particular times and places, was modified in its operation.

What confirms this idea is, that this sweating disease never appeared as an isolated epidemic, but was always contemporary with the common plague in other countries; that is, it formed a part of the general effects of the pestilential principle. Thus in 1483, about the time of its first occurrence in England, all Europe was desolated by the common plague. Denmark lost half of its inhabitants, and many other countries fared very little better. The same may be observed of its subsequent returns, and of its prevalence in Ireland, Holland, France, and Germany. This is what I call a revolution in pestilence, and it will apply to many other changes in the predominant diseases of the human race*.

Thus

* It astonishes me to read in modern books the positive assertions, "that the plague is never generated in Great Britain, or other northern latitudes." See Mead, James's Medical Dictionary, Cullen, Encyclopedia, and other original works and compilations without number. Lord Verulam, Sir Thomas Moore, Boyle, Erasmus, Diemerbroeck, and other luminaries of former centuries, who saw the plague frequently

Thus the petechial fever which ravaged Europe in the sixteenth century was called a *new* disease; but I conceive it to have been no more than a varied form of the common purple fever, induced by some general variation in the elemental cause of epidemics, or by the seasons. It formed a part of the pestilential series, and was the precursor of the plague, as it is to this day, although it has rarely been so general or fatal as about the year 1556, and from 1570 to 1576.

It is remarkable also, that the general cause extended over the Atlantic, and gave the same character to the fevers of the West Indies. The disease which reduced the forces of Sir Francis Drake at Carthagena in 1586, was called *calenture*; a species of malignant spotted fever.

Purchas. vol. iv. 1182.

A similar fever infected the people under Sir Thomas Gates, bound to Virginia, in the begin-

frequently in all its varieties, never pretended that the disease was not produced in their respective countries. The *Sudor Anglicus*, not only appeared *first* in England, but for the first time of its prevalence was confined to Englishmen. Yet this was the most violent and destructive form of the plague that ever has been known.

"Nuper novum pestilentiae genus immisit Deus, letiferum sudorem, quod a Britannis exortum, incredibili celeritate per orbem longe lateque diuagatum est—plurimum exitio, summo terrore omnium."

Life of Erasmus, 347.

How respectable writers can overlook such authorities, is to me inexplicable.

ning of the last century. And if Ulloa is correct in stating that the infectious yellow fever never appeared at Carthagená till about the year 1730, we have a remarkable proof of a revolution in the diseases of that climate. We are to conclude, from the facts, that the calenture was a distinct form of the pestilence incident to the country till the beginning of the present century; since which it has assumed the character of our bilious plague. I am, however, inclined to question the fact. Certain it is, that the true yellow fever has been known in the English islands from their first settlement. It reduced Cromwell's forces when they first took Jamaica in 1655. It is further to be observed, that the true form of plague is never known in Spanish America. But at Quieto, and other places, malignant distempers, under the name of *spotted* fevers and pleurifies, sweep away prodigious numbers of people, and fall but little short of the inguinal plague.

Ulloa, vol. i. 279, 281.

Such then is the pestilence of South America; but in other periods it may take a different form.

These observations also lead to an explanation of the phenomena of the angina maligna. It was called a *new* disease in Spain and England, when it first appeared in 1610; but this is a mistake.

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It is evidently described as epidemic a century or two before those periods. But the truth is, *that form* of pestilence had disappeared for a long period, and given way to some other disease. After a time it re-appeared, perhaps with some new symptoms.

The same remarks apply to the Hungarian fever, the peculiar symptoms of which first occurred in the sixteenth century; and to a multitude of local and temporary epidemics which have been called, on account of some singular symptoms, *new diseases*.

These facts serve to explain my idea of the disappearance of the plague in certain parts of Europe. I consider the angina maligna as pestilence of the worst kind; and its occurrence in modern times, since the glandular plague is less frequent, may be only one of the revolutions in diseases of a malignant type which have marked other periods. The destructive force of the pestilential principle falls principally upon the throat instead of the brain or the glands, and mostly upon youth. This may be the principal form of pestilence for a century or two, when it may disappear and give way to the common plague, or to some new combination of symptoms which shall pass for a *new disease*. A conjecture of this kind is authorized by several changes in the general characters of diseases at particular periods of the world. I do not therefore consider it to be *certain*, that the
parts

parts of Europe which have escaped the plague for a century are secure of permanent exemption from that calamity.

This conjecture seems to be authorized by the evident mitigation of the plague in the Levant within a century. Plagues are obviously less frequent and less severe in Egypt and Turkey than they were in former ages. This remark I believe to be new, but it is a fact; and this mitigation corresponds in time with the disappearance of the disease in the healthy parts of Europe. From this circumstance I conclude that this change is the effect of some general cause in the state of the elements.

This opinion may derive great strength from revolutions or changes in the natural world, analogous to that in the character of epidemic diseases.

It is generally supposed by philosophers, that earthquakes are less frequent and violent in modern days than in the first centuries after the christian æra, and the imperfect survey I have taken of their history, gives me reason to believe the opinion well-founded.

The eruption of volcanoes is very often suspended for a long period. Etna was quiet about forty-five years at the beginning of the present century. The volcanic mountain in Teneriffe, which had been quiet ever since the year 1704, again discharged its fires in August last, after a suspension of ninety-four years. There are other

volcanic mountains that have flumbered for many centuries, as Lipari near Sicily.

The aurora borealis has its revolutions. Sometimes it disappears for half a century or more; then returns, and frequently illuminates the heavens.

The seasons on a smaller scale manifest analogous revolutions. At certain periods we have mild winters, very little frost and snow, with southerly winds for a series of years. Then we have a number of long severely cold winters in succession, with violent tempests, deep snow, and perpetual north westerly winds. No less various are our summers as to heat and moisture.

The vegetable kingdom exhibits similar changes, for which no visible cause can be assigned. When our ancestors first settled Massachusetts, they raised wheat on the eastern coast in the counties of Plymouth, Middlesex and Essex; but in the year 1664 mildew appeared for the first time to injure that useful article; and since that time it has not been possible to raise wheat within a considerable distance from the sea shore.

It is related by the French that wheat had not been known to mildew in France until the year 1550. Van Helmont, p. 1093. In 1770 the potatoe plant in a particular part of Scotland was attacked by a disease which was *new*; and it has since been spreading. A similar fact is related of the oats in some parts of the same country in 1775.

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These diseases, for they are really such among vegetables, are *new*; and, as far as they extend, they are a serious calamity. They are the pestilences incident to vegetable life; which, like diseases among men, spring up and disappear without any certain causes which are within our comprehension. It is customary to ascribe such phenomena to the *seasons*; but it would be difficult to find any *visible* or *comprehensible* qualities in the particular seasons, producing such diseases among vegetables which had not characterized innumerable seasons in former years which produced *no* such effects.

The death of prim and black thorn in our country is a similar phenomenon.

Sometimes a new species of tree will spring up spontaneously, and gradually spread where none ever grew before. The pine has thus introduced itself into Duxborough in Massachusetts within the present century. Not twenty years ago, a man was living there who remembered the first white pine that ever grew in that town; but now one eighth part of the wood-land is covered with it.

Hist. Col. vol. ii. 5.

The animal world displays similar changes and revolutions. We observe not only uncommon numbers of common insects or small animals in particular years, for which we can assign no specific cause; but we actually see certain new species of insects, and, at times, known insects

fects grow to an uncommon size. Instances of the latter phenomena have occurred in the locusts, in the frog kind, and in flies. The flies about Plymouth in 1633, and about New-London the last summer, are described as being not only distinguishable for their numbers, but for their size. Ancient authors have remarked the same phenomenon.

The millions of worms which spread over many hundred miles of territory in America in 1770, can no more be accounted for than the *Sudor Anglicus*, or any other new form of disease.

The insect which about twenty years ago first appeared among the wheat on Staten Island, and which has continued to multiply and essentially injure the crops over a great extent of country, is unquestionably a non-descript as to America; a new form of animal life. Men are fond of propagating conjectures and vulgar tales for truth. The idle story which imported this insect from Germany, and gave it the name of Hessian fly, has been proved, by careful enquiries, to be mere conjecture, no such animal being known in Germany. Yet it has laid the foundation of a durable error in natural history. So fond are mankind of this vulgar prejudice of imputing all their evils to others, that even insects must, like plague, be imported.

This insect is, doubtless, a new species of animal; it is one of those varieties which nature is continually exhibiting in the immensity of her
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operations; it is a distemper incident to that particular plant, and others perhaps in a less degree, which, like the *Sudor Anglicus*, may endure for half a century, and then disappear; or it may be derived from permanent causes destined for a longer time to annoy that species of vegetable life, like the mildew on the same plant on the maritime borders of Massachusetts and New Hampshire. The mammoth of Siberia and America, whose enormous bones are seen in our museums, and whose race is supposed to be extinct, may be another instance of perpetual revolution in the works of nature.

The lofty pine, the glory of the forest, covers immense tracts of our native wilderness; but when cut down, is not propagated from the roots or stump like most other trees. Yet I am told, that in Carolina, whenever the lands are cleared of the native woods, the young growth consists mostly of pines, though far from any of that species of tree. Similar changes in the species of trees are observed, on the clearing of lands in other parts of America.

So also, on cleaning our lands in every part of America, the soil is soon covered with a full crop of white clover of spontaneous origin.

These productions are usually ascribed to the seeds of the plant scattered by birds, which lie inert while covered with shade and leaves, and germinate on the access of the solar rays. This solution is conjectural; it is, like the importation
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of the fomes of epidemic diseases, founded on mere supposition; it is the resort of careless superficial observers, who will not take the pains to extend their views over the works of nature. Do birds convey the *seeds of pine*, and of clover, and spread them over hundreds of miles of the wilderness? Have these seeds been all scattered within a few years? Or will the seeds endure the frost, the rain, and the heat of ages without perishing or germinating? Besides, birds feed on the seeds of other grasses and plants, as well as those of white clover. Why are these not spread over our woods in the same manner?

The phenomena of the forests in America preclude the probability, or rather the possibility of such events. The new plants that spring up are generated by new powers in the elements, occasioned by different combinations of heat, moisture and air, introduced by the labours of man; combinations which could not exist while the ground was clothed with trees of other species.

Plants are furnished with seeds for the purpose of propagation. This wise provision of a beneficent Providence is highly useful to man, and to animals which subsist on the seeds. But seeds are not necessary to the production of plants in all climates. Every vegetable has some spot on the globe where it is indigenous, where it was originally produced without seed, and where it will best thrive, and grow to the highest state of perfection.

fection. Such was the origin of most of the plants now known to man. The principles of animal and vegetable life were contemporary with the formation of the earth. New species are generated only by those gradual alterations visible in the operations of nature, or by accidental changes, induced by extrinsic and artificial causes.

Animals are also produced very often without any parent but the elements. Hear what is recorded by that accurate observer Dr. Lind, on the diseases of hot climates, p. 208. "It is a phenomenon incontestibly true, that in stagnating pools of water at Bombay, produced solely by the rains, and which have no communication with any river or the sea, living fish are generated; many persons have eaten of them. Upon the drying up of the pools they die, and are frequently very offensive."

I have not the least doubt of this fact: and it is on this principle only that we can account for the existence of fish of various kinds, and eels, in brooks and ponds on the tops of hills, above impassible falls, and in lakes which have no outlet. And we prove the generation of such animals in the places where they exist, not only by the impracticability of their finding a passage to such situations, but by the fact that many species of them are never found in salt-water, and probably could not exist in it. Any person may be convinced of the utter impossibility of fishes making
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their way to the heads of many small streams, where they are found, by examining innumerable such streams on our mountains, which are full of trout and other small fish, above perpendicular falls among solid rocks, of 50 or 100 feet in height.

The truth is, the elements of air and water are fitted to produce animals of the kinds proper to subsist in them; and so are plants. Not a vegetable in the field is formed without its worm, its fly, or other insect, which it generates or feeds; and the animal, when peculiar to a plant, has the colour and the properties of that plant. Not a species of vegetable or animal matter, exposed to a suitable degree of heat and moisture, which does not produce its insect. Even living animals are not an exception. Are not the large worms formed in the human stomach possessed of animal life? And are they produced by a germ deposited by an animal of the same kind? Not at all; the supposition is ridiculous. They are a disease, caused by the operation of heat and moisture on substances in debilitated stomachs, which fail to perform the usual digestive functions*. All animals and plants have their diseases, and the mildew on wheat, and the fear on

This is the common theory: some persons suppose them not a disease, but part of the animal economy necessary to full health. This, however, makes no difference as to the manner of their production.

vines, are probably the effect of *debility*—that is, of the defective energies of the elements, and consequent defective process in the vegetable functions; or of insects which are the produce of the irregular operations of the elements.

In the year 1788 a horse was publicly exhibited in Philadelphia, with a living animal, of the worm species, in his eye.

See Museum, vol. iii. 500.

A worm of three inches in circumference and twenty inches in length, was found in the liver of Mrs. Holt, of Philadelphia.

Ibid.

When these facts are known and acknowledged, will men still be found to deny the doctrine of equivocal generation?

All creation is full of these varieties. Even the stellary regions exhibit new stars, either stationary or revolving, which are visible for a longer or shorter time, and then recede from human view. Other luminous appearances, resembling a lamp, a spear, a beam, are often observed, for which we can assign no cause. The new stars may be revolving bodies, which appear to us only in a particular part of their orbits;

It is not an unusual thing for worms to be generated in the small ulcerations produced by pestilence on the surface of the body. Such is the power of excitement. Several instances have been mentioned in this work.

but

but other singular celestial appearances are doubtless mere variations in the forms of the element of fire.

The fish in the ocean are subject to the same revolutionary laws. They often abandon the banks where they have appeared for centuries, and appear in places where they were never before known. They are subject to epidemic maladies as much as man or cattle; they often sicken and die; and sometimes it appears, that the whole species frequenting a particular bank is suddenly extinguished.

The changes in the diseases of men; all the phenomena of epidemics, in their origin and disappearance, their increased violence and novelty of symptoms, are the effects of similar alterations in the elements which compose the system. We are but one species of animals, whose bodies are composed of the same materials, and subject to the same laws as the bodies of all other animals. Animal and vegetable substances are also composed of the same elements, variously combined; they are simply varieties in the forms of matter endowed with life. And the intellectual endowments of man, with all his boasted pre-eminence, cannot exempt him from the operation of the general laws which govern every other form or combination of the elements.

NOTE, ON THE VENEREAL DISEASE.

I am really surprized to observe, with what pertinacious obstinacy men persist, in face of the most incontestible evidence, upon fathering great evils and calamities on others. The description of Adam's casting the blame of his sin on Eve, and Eve's charging the whole to Satan, had it been intended to illustrate the practice of tracing diseases to a foreign country, could not have been a more exact representation of the fact, and of the disposition of men to shift off, not only crimes, but even moral and political evils, and cast them on their neighbours. Every nation and every man conjures up a devil, to which all that is *evil* and *dishonourable* is to be imputed. Pope has well described this disposition.

"No creature owns it in the first degree,

"But thinks his neighbour farther gone than he;

"Even those who dwell beneath its very zone,

"Or never feel the rage or *never own*."

The people in the north of Europe maintain most strenuously that the plague never originates in their countries. Mead even affirms that the measles, as well as small-pox, had its origin in Egypt.

The inhabitants of Egypt declare, that the plague does not originate in *their* country, but is always imported from the north, as Constantino-ple, Smyrna, Greece, or Syria; or from the Bar-
bary

bary-Coast; and this silly notion is actually believed and circulated by most reputable travellers. The inhabitants of Constantinople, I believe, admit that the plague *may* originate in that city; but it is believed by many persons, that this disease does not originate there, and they trace it to Egypt. Many Europeans have adopted this opinion.

In Smyrna, Syria, Cyprus, and all parts of Europe, the plague is ascribed to foreign countries. In Algiers and Fez, and all along the Barbary Coast, the plague is held to be imported from Egypt or Constantinople. It is immaterial which; the great point being to shift off the origin upon neighbours.

Just so in America; it is not admitted, by a great portion of people that the climate can generate a pestilence. The yellow fever, which is the plague of the country, is, in popular opinion, always imported from the West Indies. When we go to the West Indies and enquire for the origin of this disease, we are told very gravely that it does not originate there; it comes from Siam and Bulam; and books are written by able physicians to prove the disease *imported*.

If, then, we are to believe the opinion of the inhabitants of any given country, and their own story to be just, we shall prove that the plague and yellow fever are generated in no country

on earth*. There is something extremely laughable in these facts; but to philosophy, to medical science, and national candour, they are as disgraceful as they are prejudicial. My enquiry into the histories of these diseases has demonstrated to my mind, that most pestilential diseases have originated where they existed; and no one of them will spread or exist long in an atmosphere in which it will not originate.

The small-pox does not usually spread without infection, but I can prove, by many instances, that it does originate in sporadic cases without infection. In South America it spreads and becomes epidemic in certain periods, then totally disappears.

Ulloa, book vi.

The venereal disease appears to be propagated solely by infection; it must, however, have originated at first without infection, and *may* still, for ought we know, originate in the same manner.

But the attempt of physicians to palm this disease on the natives of America, is a most gross and abominable attack on truth, persevered in against the plainest and most indubitable evidence.

“ But where the extreme of vice was ne’er agreed;
 “ Ask where’s the north? at York, ’tis on the Tweed;
 “ In Scotland, at the Oreades; and there,
 “ At Greenland, Zembla, or the Lord knows where.”

Essay on Man, ii. 221.

In the annals of England, there is the clearest proof of the existence of that disease in the twelfth century; and it was the subject of legal provisions as early as the year 1162, which laws are still extant, and were then only a renewal of those which were still more ancient. In the records of the Lordship of Winchester there are many regulations respecting the stews which were authorized to be kept in Southwark; one of which expressly prohibits any "Stew-holder to keep any woman that hath the *perilous infirmity* of (brenning) burning*."

In a book written from a manuscript about 1430, in possession of the Bishop of Winchester, one article begins thus; "*de his qui custodiunt mulieres habentes nephandum infirmitatem*," it goes on "*item*. That no stew-holder keep noo woman wythin his hous that hath any sickness of brenning, but that she be put out, upon the peyne of make it a fyne into the Lord of a hundred shillings."

That this was a common disease, appears from the frequent mention of it in those records; and that it was the same disease now called *venereal*, appears from the description of it given by Arden,

* *Burning* is a modern orthography; the ancient was *brent brenning*. So Chaucer wrote it. *Canterbury Tales*, 2427, and in other passages.

"The fires *brent* upon the auter bright,
"That it gan all the temple for to light."

physician to Richard II. and Henry IV. between 1377 and 1413, who speaks of it as a "certain inward heat and excoriation of the urethra."

This disease was called a *burning*, and went by that name till the middle of the 16th century.

See Philosophical Transactions, No. 357.

Baddam's Memoirs, vol. vi. 390.

It is asserted by European authors, that this disease was prevalent among the natives of America when the Spaniards first visited the country. I cannot controvert the assertion; for I do not possess the original Spanish histories of their first voyages. But it is *possible* this may have been true. It is somewhat strange, however, if that disease was formerly very prevalent among the natives, that, in modern times, it should hardly be known among them.

Ulloa, in his Voyage to South America, book vi. declares, that the "venereal distemper is seldom known among the natives," although so common among the Spaniards as to have lost the infamy attached to it in other countries.

See also book v. ch. 6*.

With

* These remarks on the origin of diseases proceed solely from my love of truth and sound philosophy. I am no more anxious to exonerate the savages of America from the charge of communicating lues venerea to Europeans, than I am to vindicate Egypt from the charge of originating all the plagues that have desolated Europe. It is my wish to

prostrate

With respect to the origin of the lues venerea we are left in the dark, as we are with respect to the small-pox. It is agreed, on all hands, that none of the Greek and Roman writers on medicine have described the disease.

But there is not a shadow of doubt that a species of this disease existed in England as early as the Norman Conquest; and, probably, in the other countries of Europe. Not a medical work of that period, if any was written in the West of Europe, has survived the ravages of time; and we are indebted to the legal establishment of stews in Southwark for the evidence of the existence of that disease.

It is, however, not at all improbable, that about the year 1496 this disease might have acquired some new malignant symptoms, and spread with a fatal rapidity that might alarm mankind, and render the distemper more an object of notice. Antecedent to that period, it might have been

prostrate that system of error, respecting the origin of pestilential diseases, which disgraces modern days.

The following remark is of less consequence. The British dictionaries define the word *Buccaneers* by "Pirates of America, or American pirates." But names lead to error. The buccaneers were all originally Europeans, French and English, who committed piracies in the West Indies and Spanish America. *Encyclopedia*, article *Buccaneers*. — Thus the name "*Hessian fly*," given in this country to a mischievous insect, is the offspring of ignorance and the parent of a material error in common opinion.

CONCLUSION.

much

much more mild and less destructive. This idea is greatly strengthened by the known fact that other diseases had, about the same time, undergone similar changes. It was but about ten years before that the plague took the sweating form—an event as novel as the generation of a new disease. What is more remarkable, in the very year assigned for the appearance of the lues venerea, an epidemic leprosy overran Germany—an event equally novel. These facts confirm my ideas of certain revolutions in the symptoms of diseases, corresponding with material changes in climate or modes of life.

CONCLUSION.

CONCLUSION.

*Addressed to the learned Societies in America,
Europe, and Asia.*

THE preceding history of epidemic diseases was undertaken solely from a desire of investigating the truth, respecting the origin and phenomena of those terrible scourges of the human race. When the pestilence appeared in the United States in 1791 and 1793, I had not a suspicion that the popular doctrines respecting contagion are not well founded. The frequent recurrence of the disease in subsequent years, in opposition to all the best efforts of health officers, in executing rigid laws of quarantine, had, in 1795, shaken my confidence in those doctrines. My investigations in that and the next year, convinced me that the pestilential fever which has visited so many parts of America is generated in the country; but still I had not the least suspicion of a connection between epidemic diseases. The investigations of the year past, have resulted in unfolding principles and facts to me altogether *new and surprizing*; they cannot therefore be ascribed to a wish to establish a preconceived theory.

These

These results not only confirm my suspicions that the pestilence of America is of domestic origin, but they overthrow the preconceived system of the origin of pestilence in temperate latitudes, from fomes conveyed to these climates from southern regions; and demonstrate that it originates occasionally in all latitudes, from the 25th to the 65th. It is demonstrated that pestilence, in temperate latitudes, is never an isolated epidemic, but the crisis of a series of epidemics; and we are furnished with the means of determining unequivocally the character of pestilence, in every case, on the following simple principles.

If, on the appearance of pestilence, in a particular place, all other diseases cease, or take some of its predominant symptoms, that pestilence is generated in that place, and dependent on the state of the elements.

It is impossible, on physical laws, that this criterion should ever fail.

Another criterion, almost infallible, is the prevalence of certain diseases before and after the pestilence. If pestilence is immediately preceded by measles, affections of the throat, inflammatory or typhus fevers, with anomalous symptoms, and especially by catarrh, that pestilence is an epidemic produced on the spot, and only the *autumnal* form of disease—the other diseases preceding and following being the *vernal* and *hy-bernal*

bernal forms, produced by the same general principle.

Of the pestilences which afflict mankind, in all climates, an immense proportion, probably nineteen twentieths, belong to this species: They are epidemics beginning and ending at the command of the elements, under the co-operating influence of seasons and local causes.

These epidemic pestilences are more or less infectious according to their violence, or the places where they exist. In close rooms and narrow alleys they are dangerous; hence their mortality in fleets, camps, jails, and particular parts of cities. But the infection of such diseases extends to the distance of a few feet only, and is capable of dissipation in a free air, so as to reduce the danger of attending the sick almost to nothing. The same is true of diseases of mere infection, not epidemic.

Diseases dependent on infection only, are sometimes brought into cities and hospitals, and occasion considerable mortality. But they are propagated by contact or near approach only, and do not affect the character of other diseases current in the place.

The consequence resulting from these principles is, that *epidemic* pestilence is not under human controul—but diseases propagated by mere infection may be arrested and subdued.

The

The only means of avoiding or mitigating epidemic pestilence are, first, to withdraw the aid of local causes; secondly, to fit the body, by modes of living, to resist the causes; and, thirdly, on failure of these, to remove from the place where it exists.

The infection of all diseases, even those of specific contagion, as small-pox and measles, may be avoided by keeping at a distance from the diseased. The infection of diseases not specifically contagious, as plague, yellow fever, dysentery, and jail fever, may be nearly destroyed by free air and cleanliness.

With respect to the primary causes of epidemic diseases we are in the dark; but we are certain, from all history and modern observations, that those causes affect every species of animal and vegetable life.

The opinions which I have suggested concerning the general cause, seem to have a foundation, in the coincidence of epidemic distempers, with numerous electrical phenomena. At the same time the reader will consider these opinions rather as *conjectural* than *positive*. No certain conclusions can be drawn from an interrupted and imperfect series of facts. More materials are necessary to enable us to erect a theory of epidemics which shall deserve full confidence.

The common doctrine of contagion is utterly insufficient and unphilosophical; for, if admitted,

it

it never leads us nearer to the cause. If we trace the yellow fever to the West Indies, and the plague to Egypt or Constantinople, we are not an inch nearer to the source; for these distempers are not always to be found in those countries, and the people there are as much puzzled to find the source of them, as the inhabitants of Great Britain and America.

If we trace these diseases to the Coast of Africa or to Siam, we are as distant as ever from the source; for many times they are not to be found in those countries, and seldom are they ever found within the tropics, except among foreigners.

Indeed nothing is more common than for the yellow fever to be *imported into the West Indies in vessels directly from the United States*. When vessels from northern latitudes have long passages, it often happens that seamen are seized with the disease before they arrive at the islands, and the West Indians might often allege, with truth, that the yellow fever is imported in such vessels, when it does not exist in the United States.

In short, the doctrine of deriving all pestilential diseases from contagion or infection, were it not for the immense mischief it does to society, would not deserve a serious refutation. *Infection* is a subordinate cause of the propagation of malignant distempers; but is itself an *effect* of some more general cause, whose force is a hundred fold more powerful and formidable than that of infection.

For

For the purpose of collecting facts, the only safe foundation of principles, and comparing the phenomena of the diseases and the elements, which occur nearly at the same time in different countries, I sincerely wish and request that all medical and philosophical societies, would undertake to register facts, and reciprocally to communicate them by means of a general correspondence. The facts so registered might be comprized under the following heads :

The time of the appearance and disappearance of any epidemic disease, with its general history.

The places where it first occurs to be described in regard to land and water, height of the ground, construction of the city or streets—position as to points of compass, woods, morasses, &c. The classes of people most generally affected—the general state of seasons as to heat and cold, drought and moisture.

The time of earthquakes, meteors, lumen boreale, and all singular celestial appearances—unusual storms, especially when accompanied with hail—all compared with the lunar phenomena.

The appearance of unusual insects of all kinds, and any circumstance attending them.

Diseases among cattle, sheep, and other animals—sickness and death of fish of any kind.

Volcanic eruptions, with the phenomena preceding, attending, and following them.

For

For the purpose of ascertaining the lunar influence on the human body, or any diurnal influence, it would be desirable that medical gentlemen should note the days, and the hours of the day, when persons are seized with particular diseases, especially epidemics; the hours most fatal to the sick—the hours of exacerbation and paroxysms in fever, and the time when convalescents are most apt to relapse.—These facts should be compared with the position of the moon in her orbit, and especially in regard to her perigee and apogee; conjunction and opposition; as also with the tides in the main ocean*.

Should the principles unfolded in the preceding work prove to be well founded, they will lead to many important practical inferences.

I. If pestilential fevers never appear in the temperate latitudes without certain precursors, men will, with careful observations, be enabled to foresee the danger and prepare for it, or to use uncommon diligence in the removal of subordinate local causes.

II. If, in certain years, pestilential fevers are more predominant than in others, and the condition of the elements fitted to produce them is universal over sea and land, the fact is of no small moment in maritime affairs. Double precautions

* The time of high and low water in rivers and bays, may not be the true time in the open sea—or of the greatest and least influence of the moon.

will be taken in fleets and in merchantmen bound on long voyages.

III. If pestilence is progressive, and first manifested in certain malignant precursors, the fact may be of great utility to large cities. The approach may be perceived in time to save the inhabitants by flight, if not by other precautions.

IV. If no plague or yellow fever ever appeared in temperate climates, unless announced by other distempers, the magistracy may be enabled to distinguish when there is danger and when not; and may avoid innumerable vexations to commerce, occasioned by the rigid execution of health laws, when there is not the least danger.

V. But a most important use to be made of the facts here collected, will be to guard public health from the ill effects of bad provisions. If, in pestilential periods, salt is less efficacious in preserving flesh, and by means of a greater fermentation of the juices, fish and flesh are more readily dissolved by a putrefactive process, more caution will be found necessary in packing and re-packing them, and more care to avoid using them in a bad state.

If the effluvia of dissolving flesh and vegetables are more poisonous and prejudicial to health at some times than at others, it is of importance that, on every such occasion, early notice should be given of the danger.

If

If animals, which constitute a part of the food of men, are subject to epidemic distempers, they cannot be eaten with safety while affected by disease. When fish or fowls are sickly, and many of them die, or become lean, the fact should be ascertained by the faculty, or a board of health, and public notice should be given, that people might avoid using them as food. In some instances fish are so sickly as to excite nausea, in which case the use of them should be forbidden.

I will close this treatise with the following reflections.

In the construction of the universe we observe every part of the system to be governed by uniform laws, adapted with infinite skill to preserve harmony and order. Limited as our understandings are, we can discover many of these laws, which are calculated to impress on our minds the most sublime ideas of the universal intelligence and wisdom of their great AUTHOR.

The existence of natural and moral evils has led sceptics to question the perfections of the Author of nature. But doubts on this subject argue want of knowledge or want of candour. It is very evident that all the necessary evils of the system are calculated to produce good.

The operations of that universal principle of light, heat and fire, which pervades our system,
and

and which is incessantly compounding and de-compounding the other more sluggish materials of the earth and atmosphere, are essential to the vicissitudes of the seasons, rain, snow, hail, and dew, all which are necessary to preserve the principles of animal and vegetable life. Storms, hurricanes, earthquakes, and volcanic eruptions, however inconvenient to man at particular times and places, are among the means of giving to the principles of life more equal distribution, and of renewing their energies.

Epidemic diseases are the necessary effect of the general laws that govern the universe. But they have also a final cause of immense value to the human race. They are destined and calculated to answer most important moral and religious purposes.

Men, with their present natures, under a constant course of prosperity, would degenerate into brutes or devils. Uninterrupted ease and quiet contract the heart, and steel it against emotions of sensibility—the man rushes into crimes, or sinks into sloth. So often have I seen the hearts of men depraved, and their moral character debased by sudden prosperity, that I am persuaded the world, without frequent inflictions of pain and distress, would not be habitable.

The natural evils that surround us, intermingled with innumerable blessings, preserve the mind in perpetual vigour, in seeking the means of protection;

tion; they lay the foundation for the exercise of the finest feelings of the human heart, *compassion* and *benevolence*, which are the principal sources of social virtue; they humble the pride and arrogance of man, by creating in his mind a perpetual dependence on divine power; in short, they create and keep alive that sense of obligation and accountability to God which is the germ of piety, and the basis of moral excellence.

ADDENDA.

Of the Lunar Influence.

IT is a well known fact, that the moon has a great influence on the elements of this globe, the effects of which are very visible in the vicissitudes of weather. This influence is supposed to be the principal regulator of the tides, and the efficient cause of the changes in the atmosphere, which produce rain, hail, snow, and wind. It is believed also to affect the growth of plants, and Pliny, followed by St. Pierre, alleges that the lunar rays dissolve snow and ice. Popular opinion considers the moon as exerting a powerful influence on animal substances, and it is an incontrovertible fact that its beams accelerate the putrefaction of flesh and fish. Fishermen and sailors can all attest this fact, and it coincides with what Pliny asserts. Nat. Hist. lib. ii. 101. "*Id manifestum esse, quod ferarum occisa corpora in tabem viso suo resolvat* *." Moon light dissolves or corrupts the flesh of animals that are killed ; it renders

* St. Pierre affirms that the moon melts ice, and relies on the passage of Pliny in the chapter cited, "*glaciem refundat*"—but it is questionable whether the passage will bear that construction—and if it will, the assertion of Pliny is not

renders sound fish soft in a few hours; and fishermen are careful to cover from its rays, the fish they have caught. It probably acts upon flesh by stimulus, exciting a fermentation in the juices.

The Newtonian theory of tides, which explains the phenomena by lunar attraction, has been recently called in question and warmly opposed by the ingenious St. Pierre, in his *Studies of Nature*, who substitutes a scheme of his own, which ascribes the tides to the diurnal effusions of the polar ices. I am charmed with the writings of St Pierre, which have opened a new and entertaining volume of the works of nature. But his theory of tides seems to manifest none of that ingenuity which is conspicuous in other parts of his writings, and is utterly unsatisfactory.

In the first place, during six months or more in each polar region, no snow or ice is melted, unless by the moon. The sun is below the horizon, and the moon's influence, if it dissolves snow and ice, according to Pliny, evaporates all the water produced. This is a fact that accords with modern experiments, that ice in the night, however cold, loses a part of its weight, but it is by insensible evaporation.

To remove this difficulty, St. Pierre supposes the tides in one polar region to be the effect of the not supported by modern observations. See *Studies of Nature*, vol. i. Expl. of the plates, p. 69. Ice is diminished by evaporation in moon light, without forming water.

melting of snow and ice, in the opposite polar regions. But to this hypothesis we may oppose an insuperable objection, derived from the great and universal laws of equilibrium observed by water. A diurnal wave or elevation would inevitably subside into a level, before it could reach the equator, or even the temperate latitudes. Besides, the Atlantic is of very various breadth, in different latitudes. Between the coast of Brazil and Terra Firma on one side and Africa on the other, the breadth is scarcely half as great, as in the latitude of 25° North. A diurnal wave, compressed and dilated in those different situations, must exhibit the tides in one place twice as high as in another; but in the regions mentioned this is not the fact,

In America we have, every spring, the clearest evidence that the tendency of water to an equilibrium, utterly overthrows St. Pierre's hypothesis. In the months of March and April the snow and ice in New-England are dissolved, and the water is poured into the large rivers: when this operation is performed by the heat of the sun, which is most generally the case, the water made by melted snow is diurnally poured into the small streams, which communicate with the large rivers.—During the night this operation ceases, and instead of thawing, the cold is usually sufficient to freeze water. These diurnal effusions are often immensely great, and wholly suspended during the night; yet within

within forty-eight hours, and in the course of 200 miles currency, in a large river, the water acquires a level, and no diurnal rise or fall is observable. This fact in Connecticut river, the Nile of America, has been under my observation for a number of years.

There are many of the phenomena of the tides which cannot be explained on St. Pierre's hypothesis; but the foregoing remarks are sufficient for my present purpose. The tides, doubtless, depend on lunar and solar influence; but the phenomena cannot be solved on the common theory of *attraction*. In this respect, I am confident the Newtonian theory, as explained by Kepler and others, is as inadequate, as that of St. Pierre. The latter author has enumerated some insuperable objections to that theory, to which the reader is referred. But I have other observations to make on this subject, which are probably new.

The manner in which astronomers have attempted to explain the opposite tides, is as follows:—"The power of gravity diminishes as the square of the distance increases—therefore the waters on the side of the earth next to the moon are more attracted than the central parts of the earth; and the central parts are more attracted by the moon than the waters on the opposite side of the earth—therefore the distance between the earth's centre and the waters on its surface, under

and opposite to the moon, will be increased.— The earth by its gravity falls towards the moon—the water directly below the moon rises and swells towards her; the water on the opposite side recedes from the centre and rises; or, strictly speaking, the centre recedes from the water. On the sides of the earth between the points under and opposite to the moon, the water is depressed and falls below the former level.”

See Ferguson's Astronomy on the Tides, and Encyclopedia, Art. Astronomy, 363.

As I am not about engaging in astronomical or mathematical calculations, I shall content myself with stating these general principles of Newton, Kepler, and later astronomers, with a few objections.

I. This theory does not explain, in a satisfactory manner, the reason why there are no tides in lakes and Mediterranean seas.

If the principle is just, that the earth recedes from the water opposite to the moon, leaving the surface of it at a greater distance from the centre, why, when the Euxine or Mediterranean is opposite to the moon, does not the earth between these seas, recede from *their* waters, as well as from the waters of the ocean in the same longitude? The earth consists of solid substances, and, by the laws of attraction, must, in all its parts, be moved equally, under the same circumstances

of distance from the attracting body and density, or solid contents. To suppose the earth, when covered by an ocean, to be attracted by the moon, and not when covered by a lake or arm of the ocean, is, in my view, neither logic nor philosophy.

Nor is the reason assigned for the defect of tides in lakes and seas, on the side next to the moon, in the least satisfactory. It is found in the Encyclopedia in these words: "There are no tides in lakes, because they are generally so small that when the moon is vertical, she attracts every part of them alike, and therefore by rendering all the water equally light, no part of it can be raised higher than another."

But this explanation does not meet the difficulty. The Newtonian theory stands on the hypothesis that the waters on the side of the earth next to the moon are more strongly attracted than the adjacent land; therefore they rise above several feet of the earth. But the solution above recited does not reach this point; for the waters of the ocean rise *higher* than the contiguous earth; but the waters of lakes always observe the same relative altitude on their shores. If then the moon attracts the waters of lakes at all, or occasions them to rise, it attracts the adjoining earth, and raises it the same degree as the waters; but in regard to the ocean, it attracts the water, and leaves the contiguous earth behind. In short,

short, if attraction and gravity have uniform laws, as we must believe they have, the attraction of the moon will *not* account for tides in the ocean, while there are none in lakes and inland seas.

II. If the moon's attraction is the cause of tides, why is its force much less in the equatorial regions, than in the distant parts of the globe? It is a well known fact that the tides within the tropics are very small, and that they are more considerable as we recede from the equator towards the poles. This is contrary to what ought to be the case, on the principles of attraction; for, on the Newtonian theory of gravity, the highest tides should be on the parts of the earth nearest to the moon. The reverse of this is the case, and the circumpolar regions of the earth have the highest tides.—The tides within the tropics are from 12 to 24 inches—in the latitude of Greenland, almost as many feet.

III. The theory of Newton is not reconcileable with his own principles of gravity, which suppose the force of it to be equal to the quantity of matter contained in bodies. Now the theory implies, that on the side of the earth next to the moon, the water is attracted *more* than the earth; but on the opposite side, *less*. This cannot be solved on the principle of *distance*; for this is too small to account for a hundredth part of the effect. Indeed the water and the land on the shore, may be considered as at the same distance.

Nor

Nor can it be solved on the principle of a difference in the quantity of matter in earth and water. If the earth, having more density and matter, is most attracted, the principle must act uniformly on both sides of the earth; on both sides the earth must move towards the moon further than the water; which is contrary to fact.

If the water has most matter, the same principle must govern it on both sides of the earth, and move it farthest towards the moon.

But here the principles of cohesion interfere with all these deductions. These principles are so powerful as to overcome the attraction of a distant body, nor is it to be supposed that the power of the moon overcomes the force of cohesion, and, by attracting the parts of the earth next to it more than the parts on the opposite side, changes the form of the earth from a sphere to a spheroid. It is not supposed that the whole solid mass of the earth is continually changing its figure by means of lunar attraction. If so, this figure must be rotatory.

The theory, then, supposes that on the side next to the moon, the water is most strongly attracted, and rises above the earth; but on the side opposite, it is attracted less than the earth. The solid globe is moved towards the moon, and the water left lagging behind! What is more singular, the earth near the equator on the side
opposite,

opposite, is drawn only two feet further towards the moon than the water, or perhaps but one foot; while, in the temperate latitudes, it is drawn six or eight feet, and, in the latitudes of 60 and 70 degrees, fifteen, eighteen, and twenty-five feet further than the water. This may be philosophy; but to me it is utterly unintelligible!

Nothing is a more serious misfortune to science than the errors of a Great Man. Most of mankind take principles and facts upon trust, and defend them with a zeal proportioned to their confidence in the man who has published them. I revere the character of Newton, of Kepler, and of Haller; but this veneration does not in the least incline me to receive their doctrines without being convinced that they are well founded. After most careful investigation, I am satisfied that the principles of attraction will not account for the tides opposite to the moon, nor for the difference between the height of the tides in different latitudes; yet I have not the least doubt that most of the phenomena of tides are regulated by the moon.

If I was asked, on what principles the tides depend, my answer would be, *I do not know*. But numerous facts, all concurring to the same point, lead me to *suspect* the vibrations of the ocean to depend on electricity, influenced by the moon, the sun, or other distant orbs, and acting by repulsion as well as attraction, or by increasing and diminishing the elasticity of the water.

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In the first place, it is agreed among philosophers, that the air, when free from vapour, is an electric; that when cold, it is most electric; and when heated, it becomes a conductor; and, consequently, that the atmosphere in the torrid zone is always in a conducting state, while the air of the northern regions, if clear, is an electric. In short, it is agreed that the atmosphere of the temperate and frigid zones contains more electricity than that of the torrid zone.

These facts correspond with the phenomena of tides. In the regions where there is the least electricity, there is the least intumescence of the ocean: those are the equatorial regions. There the temperature of the air also sustains very small variations; so does the height of the ocean. As we recede from the equator, cold and electricity increase; so does the elevation of the tides.

Again, the same train of phenomena attends the barometer. Within the tropics, the variations of the mercury in this instrument are very small; but in the temperate and cold regions they are more considerable, and increase as we recede from a warm to a cold, electric atmosphere.

Similar phenomena attend the twilight. Within the tropics the twilight is of much less duration than in cold regions. "Heat," say philosophers, "diminishes the air's refractive power and density, and cold increases both. The horizontal refractions

tions are near one third less at the equator than at Paris.

Ferguson's Affron. 97.

The density of the atmosphere within the tropics may be less than at the polar circle; but the weight is nearly the same, the barometer being in general as high at the equator as in northern latitudes. But the air in hot climates has less powers of refraction; that is, there is more power of refraction in an atmosphere that is most perfectly electric, or that contains most electricity.

It is remarkable also that, in equatorial climates, the atmosphere exhibits no visible streams of electricity, as it does in the polar circles.

I know not how far this parallel may be extended; but there is a surprising resemblance between all these phenomena. In general, then, we observe that, in the equatorial regions, the density, weight, elasticity, and temperature of the atmosphere, are more nearly uniform than in northern climates; and the elevation of the ocean in tides corresponds with this uniformity. As we recede from the equator, the variations of the atmosphere increase, and so do the variations in the height and depression of the water.

From these phenomena a suspicion arises, that the medium by which the moon and sun act upon

upon the ocean is the electrical fluid, as their influence appears to be in proportion to the electricity of the atmosphere. Hence the highest tides at a distance from the equator, where the heat and cold, and elasticity of the air, are subject to great variations.

By what law, it will be asked, is this effect produced? I readily confess my ignorance. But the phenomena of opposite tides seem to bear a great affinity to the well-known laws of electricity, *attraction* and *repulsion*, and a positive and negative state. I pretend not to account for the phenomena; for I am persuaded that the experiments on electricity which man is capable of making, will never unfold *all* its properties, nor explain *all* the laws by which this energy of nature is exerted in the government of the material system.

But the influence of the planets on the elements of this globe has, in all ages, been a subject of belief or of derision; and surely it is a subject in physics much more interesting to man than many speculative questions which cannot affect his health and happiness, but which occupy the labours of investigating minds. I will therefore throw together a few observations which may afford light on the subject, or at least may excite a spirit of enquiry.

In the first place, it is generally known and admitted, that the influence of the sun and moon

upon this globe are in proportion to their proximity. The highest tides are when the moon is in her perigee and in conjunction with the sun, and especially when the earth is in her perihelion, or nearest to the sun. But the moon exerts more than usual influence on the atmosphere in other positions. Her power is greatest in her perigee and apogee, and in her conjunction and opposition to the sun. Her influence on the tides, under the combined and separate operations of these circumstances, has been fully illustrated. But her influence on vegetation, on the vicissitudes of the weather, on health, and the phenomena of the electrical fluid in earthquakes and volcanic eruptions, seems to have passed unobserved, or at least to have never been reduced to any thing like system.

One of the most striking effects of lunar influence is observable in earthquakes, which usually happen near the time of the moon's perigee or apogee, conjunction or opposition. As this fact seems to have escaped observation, I will here insert proof of it.

The great earthquake which demolished Lima on the 28th day of October, 1746, happened six hours before the full moon, and the day before her apogee.

That which destroyed Lisbon, Nov. 1, 1755, was three days before the change, and four before her perigee.

The great shock in America, on the 18th of the same month, was a few hours after the full moon, on the day of her apogee.

The great earthquake in America, on the 2d of June, O. S. 1638, was on the day after the new moon, and one day before her perigee. (Some accounts place this on the first of the month; in which case it was the same day with the change.)

The shock which convulsed America, and demolished mountains in Canada, January 26th, O. S. 1663, was on the day preceding the new moon.

The great earthquake in S. America, June 3d, O. S. 1744, was four days after the new moon.

The memorable earthquake in North America, on the 29th of October, O. S. 1727, was about three days before the new moon, and on the day of her perigee.

The shock in America, on the 29th of November, 1783, was on the day after the moon's perigee.

That on the 16th May, 1791, was on the day of her perigee, and one day before the full moon.

The shock on the 1st of November, 1761, was the day before her apogee.

The great earthquake in Iceland, on the 10th of July, 1789, was on the day of her apogee, and three days after the full.

That in Tuscany, on the 30th of September in the same year, was two days before her apogee, approaching the full.

A shock at Lisbon, on the 27th of November, 1791, was two days after her perigee and change.

A shock on the 15th of January, 1791, in Virginia, was two days after her apogee, and approaching the full *.

These two last instances, according to another almanack, happened *one* day after the perigee and apogee. I have not taken pains to enter into *exact* calculations of the moon's place, as I do not deem it material. It is sufficient for my purpose that *almost all* earthquakes happen near the time of the moon's conjunction and opposition, or her perigee and apogee. Of these positions it is obvious that her perigee and apogee have much the most influence; and the instances I have examined are almost equally divided between these two positions. Of all the earthquakes which I have compared with the moon's place, one or two only fall in her quadratures, and at her mean distance from the earth. An instance happened on the 11th of April, 1799, in Carolina. I have compared several other instances, which happened near the perigee and apogee; but it is un-

* A severe earthquake in the west and north of France, on the 25th of January of the present year, 1799, was a few hours after the moon's perigee.

necessary to specify them. The examples mentioned will establish the generality of the fact, and the soundness of the principle.

On the principles of *attraction*, it will readily be admitted that the proximity of the moon to the earth, at certain periods of her revolution, must *draw*, or excite into action and discharge, the electricity of the earth. This accounts for earthquakes during the moon's perigee. But on enquiry, we find a great proportion of the shocks take place during her apogee, where her distance is greatest and her power the least; and not only so, but during her opposition to the sun, when her *diminished* influence is supposed to be counteracted and still *further diminished* by the attraction of the sun. This is an important fact, and deserves investigation. That the influence of the moon is the direct exciting cause of earthquakes, can hardly be questioned, after establishing the fact that four out of five; or a much larger proportion, happen when she is in particular parts of her orbit; but why her greatest distance, and her least, should produce exactly the same effects, a fact equally well established, is a question which can perhaps be solved only on electrical principles.

That the electricity of the atmosphere and earth is the medium by which the moon acts upon the elements of the globe, is rendered probable by another fact. I possess the exact dates

of very few volcanic eruptions, but by comparing such as I have with the moon's place in her orbit, I find these eruptions begin, or suffer violent exacerbations, at the time the moon is in her perigee or apogee, or in her conjunction or opposition.

The great eruption of Vesuvius in 1779 was augmented on the 8th and 9th of August, when the moon was in her perigee.

The great eruption of Vesuvius, and the earthquake which buried Herculaneum, A. D. 79, on the 1st of November, were the second day after her perigee.

The tremendous eruption of Heckla, in 1783, began on the 1st of June, when the moon was in her apogee, and increased till the 8th, after which it continued to be violent for a long time.

An eruption of Vesuvius on the 10th of May, 1784, was during the moon's perigee.

An eruption of fire near Palermo in Sicily, on the 13th of March, 1785, was two days after her perigee.

An eruption of Etna, on the 19th of May, 1780, the dark day in America, was the day after the full moon.

A dark day on the 9th of August, 1732, was about the time of the new moon, and her apogee. The dark day at Detroit, October 16th, 1762, was the day after her perigee, and one day before the change,

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The eruption of Vesuvius, March 8th, 1730, was on the day after the new moon, and a great exacerbation happened on the 14th, the day before her apogee.

The great eruption of the same volcano in 1794, was announced on the night of the 12th of June, nine hours before the full moon, by a violent earthquake. The eruption took place on the 15th.

The darkness in Canada, on the 15th and 16th of October, 1785, was on the days next preceding the full moon and her perigee. The obscurity on the 9th of that month was near the quadrature.

The eruption of Heckla in 1766, began on the 15th of April, the day before the moon's apogee.

The influence of the moon in producing storms of rain, snow and wind, is universally admitted, and that these happen near the positions of the moon, already described, no man will undertake to deny. The West Indians expect hurricanes only near the time of the full and new moon; or her perigee and apogee.—This is further evidence, that the electrical fluid is the instrument of these commotions in the atmosphere. Electricity is known to be the cause of winds, and its agency is visible in producing hurricanes, for experienced seamen foretel a hurricane by the unusual transparency of the water. Now, it is a well-known

fact, that electricity possesses the singular property of giving transparency to opaque bodies.

A little before a hurricane in the West Indies, seamen can see the lead at an unusual depth: the sea also swells and rolls upon the shore in a singular manner, though the air is perfectly tranquil.—An effervescence, also, or bubbling, is observed in the water;—dark clouds are formed, and the atmosphere, before the tempest, is obscured by vapours sensibly mephitic.—See a letter from Governor Ellis, dated March 6th, 1789, in the 9th vol. of Museum, 215.—Hence we observe the correctness of the common saying among seamen, that “hurricanes come out of the sea.”—They are evidently generated by extraordinary discharges of electricity.—Hence they are most frequent in the Windward Islands, which are all volcanic; some of them still discharging fire and smoke at times, and all of them evidently resting on a volcanic base.

Further, that electricity is the great agent in these agitations of the elements is rendered probable by the coincidences in time, between the more violent hurricanes and great volcanic discharges from Etna, Vesuvius and Iceland.—Witness the terrible hurricanes of 1747, 1766, 1772, 1780, 1784 and 5, all of which happened near the time of great eruptions from the volcanoes mentioned, all of which are distinguished in the annals of the Antilles, and still recollected with horror by
the

the inhabitants. And this circumstance is no inconsiderable evidence, that the agent in volcanic eruptions, as well as in hurricanes, is electricity, and that this element is often disturbed or ejected from the whole globe nearly at the same time.

Most of the great tempests in all latitudes happen near the moon's perigee and apogee; and in these positions we observe essential changes in the temperature of the atmosphere. I have taken some pains to compare the changes in heat and cold with these positions of the moon, with a view to learn whether the effects are uniform.—On examining the state of the thermometer for two years, I find that in almost every instance of the moon's perigee and apogee, especially in winter, there was a considerable change of temperature.—Usually the weather grew colder as the moon approached her perigee; but the effects were not uniform; sometimes the weather became more temperate at the perigee:—But one general remark will be found true, that in regard to heat and cold, the moon's apogee and perigee produce at different times precisely the same effects.—This remark accords with what has before been observed in regard to earthquakes.

It is a general remark that the weather becomes cooler as the moon approaches the change. Should this remark prove to be well founded, the result would be this principle, that the cold is increased, or rather, the heat lessened by the combined in-

fluence of the sun and moon. This principle would accord with another observation just made, that the weather is cooler, during the moon's perigee, which is generally true in winter; that is, the greater power is exerted by distant orbs on our atmosphere the more the heat is diminished; but this observation is not universally true.—It is true that our winter occurs during the earth's perihelion, but this is usually explained on the principle of the obliquity of the sun's rays, a solution that, perhaps, is not completely satisfactory.

It is a popular opinion that vegetation is less rapid, and the flesh of animals less firm and substantial, and new shooting plants less vigorous during the wane of the moon, than during her increment; this opinion is too general and too respectable to be considered the fruit of ignorance and credulity.

Aristotle alleges that the close of the lunar month is cooler than the other parts of it, and that during the decrease of the moon, the bodies of living animals possess less heat than at other times. *De gener. animal.* lib. 2, 4. These remarks, whether true or not, coincide with the modern popular opinion just recited.

We are apt to neglect the opinions and practices of barbarous nations, and to hold in contempt the knowledge of ancient nations: this often happens, I suspect, because we are less wise than those whom we affect to despise. Cæsar in his first book of the Gallic War, chapter 40, relates

relates that the ancient Germans, who were great observers of the phases of the moon, declined engaging in battle during the wane of that planet.—He had offered battle to Ariovistus, but this commander declined a general action, and permitted only skirmishes.—Cæsar enquired of his prisoners the reason of this conduct, and was told that it was customary with the Germans to consult their venerable matrons, who, by means of lots and divination pronounced on the propriety of giving battle; and these had declared that it was not possible for the Germans to conquer if they engaged in action before the new moon. “*Non esse fas Germanos superare, si ante novam lunam prælio contendissent.*”

See Cæsar's Commentaries in the passage cited, and Henry's History of Britain, vol. i. chap. 4.

We have this custom of the Germans presented us, disguised with superstition, but I strongly suspect it had its origin in the observation of the fact mentioned by Aristotle, that in the decrease of the moon animal bodies have less heat and vigour.

I am more inclined to believe this, because the doctrine accords with modern observations concerning the invasion of fevers, and especially of epidemic diseases. Many medical authors concur in the fact, that diseases more generally attack the human body on the second or third day before

before the new or full of the moon. On examining the accounts of several writers, I find the times of invasion to be two or three days before or after the full and new moon, or about the time of its conjunction with the sun.

See Jackson, Grainger, Lind, and many others.

Diemerbroeck is explicit on this point.—He relates, that in the plague of 1636, “two or three days before and after the new and full moon, the disease was more violent; more persons were seized at those times than at others; and those who were then seized, almost all died in a very short time.—Many patients who appeared before to be slightly affected, *nescio qua virium labefactione oppressi*, says the author, by an unaccountable decline of strength, sunk and died in a few hours.”

De peste, p. 9.

From the observations of physicians, it then appears that this debility of the animal powers takes place near the time of the conjunction and opposition of the sun and moon, near the moon's perigee and apogee, and in the same positions in which earthquakes and storms more generally occur.

Of the reality of this effect of the elements on the body, there can be no rational doubts. About the time of the change of the atmosphere, which indicates an approaching rain or storm, persons of debilitated

debilitated habits of body perceive the change by a loss of vivacity, dulness, or heaviness; parts of the body that have lost their natural energy by means of wounds and tumours, experience painful or uneasy sensations, by which storms are often predicted.

Fowls perceive this change in the atmosphere, and manifest their sensations.—Candles sparkle and snap; the tallow melts more freely, and the flame is less steady. These things were observed by Aristotle and Pliny.

This change in the atmosphere is not only perceptible by the sense of feeling, but becomes visible. Distant objects seen over water, and some writers say, over land also, *loom*, that is, rise or appear elevated several degrees above their usual attitude. The ear, also, will aid us in foretelling rain and wind, for sounds become audible at an unusual distance.

Persons in full health are not sensible of these changes in the elements, at least, they are not so much affected as to observe them; but from many years observation I am convinced that the catarrhal affections which pass under the popular name of *colds*, are occasioned by the alterations in the atmosphere which precede changes of weather, and few of them from the application of cold. I know this to be the case with myself; those phases of the moon which have been mentioned as producing great effects on the earth
and

and atmosphere, rarely pass without affecting me with slight catarrh. This has been remarkably the case since the fever of 1798, which left me in a state of debility. But many persons can attest the truth of the principle; nothing being more common than for persons to remark, that they cannot tell how they took cold, and it being well known that catarrhs are more general and severe on the transitions from cold to heat, than from heat to cold. The obstruction of the glands is evidently the effect of an insensible change in the atmosphere, probably, by means of the decomposition of the electricity and the vapour or other elementary substances of the atmosphere. And the winds to which we ascribe the changes of weather are unquestionably an *effect*, rather than a cause of those changes.

These alterations in the atmosphere appear to have some connection with the tides, or rather with the cause of tides. It is said by seamen and other observers of the seasons, that full tides are apt to produce rain, that rain which begins at high water will cease with the recess of the tide; but rain beginning at low water will be of considerable duration. These and other observations, if just, as I am inclined to believe, manifest an influence of the tides over the state of the atmosphere, or a dependance of both on one common cause; the same invisible energy of electricity producing both effects.

It

It is a known fact that the flowing tide often brings with it a breeze of wind. This is ascribed to the friction of the water on the air, and the cause assigned may be sufficient to account for the phenomenon. But it may be suggested whether the electricity of the atmosphere may not produce both the tide and the wind. The intumescence of the ocean, previous to earthquakes and hurricanes which are evidently occasioned by electricity, seems to bear a great analogy to the tides, and to authorize my suspicions.

There are many diurnal and periodical phenomena which are evidently connected with the lunar and solar influence, and deserve to be mentioned in this place.

It is a well ascertained fact, that in the tropics where the weight of the atmosphere is subject to very small variations, the barometer uniformly rises and falls with the tides about two thirds of a line.

Encyclop. Art. Wind. This is a small variation.

But it is also asserted that in those regions, "the variations in the gravity of the atmosphere seem to depend on the heat of the sun, as the barometer constantly sinks near *half an inch* every day, and rises again to its former station in the night."—*Encyclop. Art. Atmosphere.* I suspect the words "half an inch" to be an error.

Now, if the barometer depends for its fluctuations on heat, we should suppose the same cause would

would operate in northern latitudes and occasion a diurnal rise or fall in an exact ratio to heat and cold. In this case a barometer would be a thermometer reversed, rising with augmented cold, and sinking with an increase of heat. But this is not the fact; the barometer often rises with the increase of heat between sunrise and twelve o'clock. Heat, therefore, cannot be the direct cause of the diurnal depression of the barometer in the equatorial climates, unless it has different laws in different latitudes, which philosophy will not admit.

Let us compare the facts stated with the known phenomenon of the different forces of water during the day and the night. The water-wheel of any mill, the altitude of the water and the resistance being precisely the same, makes more revolutions in a minute, during the night, than in the day time. I have long been acquainted with the fact, and it is known to every miller, but as I have never seen a statement of it in any philosophical work, I have had the curiosity to make an accurate experiment to ascertain the difference. This was done on the night after the 28th of May 1799, the weather being perfectly serene, the air free from vapour, not a breath of wind stirring to ruffle the water, and the barometer on the evening preceding, at half past eight, standing at 30.16.

The first observation was made at a quarter
before

before 7 P. M. sometime before sun-set, the thermometer standing at 65° , when the wheel of the mill made exactly 16 revolutions in a minute. The altitude of the water was marked with precision, but the delivery of the water not having been exactly adjusted to the current entering the pond, the water rose, and at nine o'clock had half an inch of altitude beyond the mark. By this means my observation at that hour was lost. By raising another gate the water was reduced to its former altitude, and by twelve o'clock the discharge of water was exactly equal to the current, and from that time to sunrise the altitude continued the same.

At twelve o'clock, and from that hour to three, the wheel made $17\frac{1}{2}$ revolutions in a minute, the observations being often repeated without a sensible variation of results. Soon after three o'clock a small acceleration was perceptible, but it did not amount to half a revolution, until about half past three, when the wheel made 18 revolutions in a minute, which accelerated movement continued till half past four, when being near sunrise, the observations were discontinued. During the last observations I perceived a very small retardation of movement, but it did not amount to half a revolution. To prevent any difference of resistance in the mill, not the slightest alteration was made in the elevation of the stone, or the quantity of wheat delivered from the hop-

per, from the beginning to the end of the observations.

I had not a barometer with me at the mill, but about eight o'clock on the following day the barometer stood about one twentieth of an inch higher than on the preceding evening. The thermometer fell during the night to 54° .

From this experiment it is obvious, that the weight of the atmosphere could not be the sole cause of the acceleration of the wheel. The acceleration at twelve o'clock was almost an *eleventh*; at a later hour a *ninth* of the whole movement. The increased gravity of the atmosphere will not account for a tenth of the difference.

We must then resort to other principles for a solution of the phenomenon. It is commonly supposed that water is a non-compressible substance, but this opinion has been justly questioned. However this may be, I have little hesitation in resolving the phenomenon of the water-wheel into its increased elasticity during the night. How, or why, the subduction of light and heat should produce or increase this property in water I leave for electricians to determine. The effect cannot be ascribed to the increased gravity of water during the night, for no such increase is observed.

It is an observation of seamen, that ships make more way in the water by night than by day with the

the same force of wind. I should expect that the moisture on the sails might, in a degree, contribute to this effect, but it must be recollected, that at sea, there is little difference in the moisture of the air by night and by day. Can the effect then be ascribed to the cause that accelerates the movement of water-wheels by night, an increased elasticity? If the gravity and density of water were augmented during the night, these would render the water more buoyant, but retard the motion of a ship, by increasing the resistance. We are therefore driven to the same hypothesis, an increase of elasticity, which renders water more buoyant when at rest and more impulsive when in motion, without an augmented density and weight. But I am not sure that the moisture of the air will not account for the whole effect.

If the elastic power of water is increased by the abstraction of heat, does it not follow that this power must be greater as we recede from the equator? and of course, any given force applied to the water in different latitudes will occasion a vibration of that fluid proportioned to its elasticity. Hence, the small tides within the tropics, where the heat is nearly uniform, and the high tides in the northern regions, where the vibrations in the temperature of the atmosphere are more considerable. Yet facts do not permit us to ascribe this elasticity to cold. It is more probably owing to the quantity of electricity, or

to its peculiar combination with aërial substances, of which cold is the effect. Perhaps, the following observations will throw some light on this subject. Aristotle, and after him Pliny asserted that no animal dies, except during the ebb tide. "*Nulum animal nisi æstu recedente expirare. Observatum id multum in Gallico oceano, et duntaxat in homine compertum.*" Pliny Nat. Hist. lib. ii. 98. "No animal dies, except during the recess of the tide. This is particularly observed on the coast of Gaul, and is at least true with respect to man."

The first part of this observation is probably too general, but modern facts confirm the assertion, within certain limitations. A late minister, at Barvie, in Scotland, contiguous to the German sea, made a similar remark after fifty years observation.

Sinclair, vol. iv. 240.

The reason why Pliny has specified the coast of France as remarkable for the fact stated, is very obvious. France lies on the main ocean, and the time of high and low water is the true time. On the coast of Italy, where there are no tides, the observation could not be made, and if made by the time of ebb tide in rivers and bays, it would not be just.

Another remark made by physicians is, that, *cæteris paribus*, more persons die during the latter

part of the night than at any other time in the solar day. This remark has not come to me from a sufficient number of observations to command full belief, but it accords with a few observations of my own. If universally true, it would contradict, in part, the remark of Aristotle and Pliny, but it is possible both remarks may be true with certain limitations. The fact may be more obvious, when ebb tide happens between midnight and sunrise, and less so when flood tide happens at that period, that is, under the combined or separate operation of the two causes.

Other facts lend their aid to support the observation, that some essential change in the properties of the atmosphere takes place in the latter part of the night. This is the time when all fevers remit or intermit. The exacerbations and paroxysms of fever invade the patient during some part of the day, and subside in the latter part of the following night.

Again, The chills that precede fevers usually come on in the same part of the day, that is, between midnight and sunrise. This is remarkably the case with epidemic diseases, as all physicians agree. The fact has been ascribed to the debility induced by sleep, but I suspect it is owing to the debility induced by the same change in the stimulant powers of the atmosphere

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which

which occasions the other phenomena above mentioned.

It is observable also, that sleep in the latter part of the night is more sound than at other times, an effect, perhaps, of the same cause.

Lind observes, that in the East Indies patients generally expire at low water; the same fact is observable at the full moon, and convalescents usually relapse at these periods.

See his Treatise on the Diseases of Hot Climates, p. 86.

From experience I can testify, that relapses usually occur at those periods of the lunar month when changes of weather take place.

Ulloa was careful to note the time of the tide when earthquakes occurred in South America, and he found them invariably to happen at half ebb or half flood, never at high or low water.

Voyage, vol. ii. b. 7. ch. 7.

There are other periodical changes in the atmosphere which deserve notice. Great storms of wind, snow, and rain, usually begin, abate and cease, at certain hours, viz. at six, nine, twelve and three o'clock, especially at six and twelve. To this remark there are very few exceptions.

Experienced accoucheurs inform me, that in lingering cases of child-bed illness paroxysms of pain recur at the same hours.

What

What is still more extraordinary, we are assured by unquestionable authority, that in volcanic eruptions the discharges are more violent at these hours than during the rest of the day. Sir William Hamilton, in his excellent account of the great eruption of Vesuvius, in June 1794, has the following passage: "The fever of the mountain, as had been remarked in former eruptions, shewed itself to be, in some measure, periodical, and was generally most violent at the break of day, at noon, and at midnight."

Universal Magazine, for August, 1795.

These are the hours when we observe the great changes in the atmosphere and sudden effects on the human body in diseases. The break of day is precisely the time when the water-wheel is most accelerated, when fevers remit or intermit, and when the patient, lingering under disease, suddenly yields and sinks into his grave.

To what cause shall these effects be ascribed? Not to lunar or solar attraction, in the usual sense of the word. Attraction is considered as a steady principle, operating uniformly under the same circumstances, and therefore the attraction of the moon, whose position in regard to the earth is every day changed, cannot account for periodical phenomena at certain hours in the day. The influence of the sun will better solve the phenomena; but how can the same principle, attraction,

attraction, operating by uniform laws, produce the same effects at two opposite hours, for instance at noon and at midnight, which certainly is the case in regard to the exacerbations of volcanic eruptions, as well as in regard to the commencement, abatement, and termination of storms?

I do not know that any principle yet discovered will solve the difficulty. But the phenomena bear a greater analogy to the operations of electricity than to any other principle in nature hitherto discovered. It seems necessary to invite to our aid repulsion as well as attraction, producing in opposite points the same effects. The nature and operations of electricity are little understood, and probably will never be brought wholly within human comprehension.

I will close this lengthy article by observing, that the phenomena of lunar and solar influence are so well understood and clearly proved as to justify, in our minds, the great attention which the ancients paid to the influence of the planets on this globe. If they went into one extreme, by ascribing too much to that influence, the moderns have erred, on the other extreme, by holding their doctrines in contempt.

The sun is the great source of light, and his rays excite the heat which exists in and around the globe. It moves this universal principle, which constitutes the energy of the material system, under the controul of infinite intelligence.

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The moon is placed in the vicinity of the earth to give variety to the seasons, and by acting on the elementary principle of heat she occasions the vicissitudes of rain, snow, fair, calm and tempestuous weather. The changes which precede and produce these vicissitudes appear to be variations in the combinations of heat or electricity, with the other elementary principles of the atmosphere. These modifications of the atmosphere, without any access of new matter, or diminution of its mass, produce difference in its density, gravity, and elasticity, with all their various effects on the animal and vegetable systems. Hence a mere modification, or new combination of electricity with vapour or other aerial substance, may increase or diminish its stimulus; during the day it may excite fever in the human body, during the night a subduction of excitement in the atmosphere may induce debility, and favour the invasion of disease and the approach of death. These are mere hints and conjectures, intended to excite investigation.

With respect to the supposed influence of comets on the elements of this globe, I would remark, that on the principles here suggested, that influence is very clearly proved and may be easily understood. The facts stated demonstrate that the sun and moon exert great powers on the globe, and the fact, that earthquakes mostly happen in
certain

certain positions of the moon, prove that the *medium* of her influence is the electric principle.

Now comets are known to be of various magnitudes. Some of them are as large as Venus, much larger than the moon, with highly electrified atmospheres, and sometimes approaching near to the earth. The comet of 1577 came within less than a million of miles distance.

Those comets which pass the system at an immense distance from the earth can have no great influence; but others, approaching near, produce tremendous effects. Hence, during their proximity to the earth, the number and violence of earthquakes and volcanic discharges; tempests, inundations from rains and extraordinary tides, and most sensible changes in the powers of animal and vegetable life. That such are the effects is proved, not only by the concurring opinions of all the ancient philosophers, who were accurate observers of nature, but by one uniform series of historical evidence, for more than two thousand years. On the principles of electricity, which is disturbed, attracted, repelled and modified in its combinations with other substances, by the approach of distant bodies, the solution of the phenomena is easy and philosophical.

On Electricity.

On Electricity.

SOME modern philosophers suppose that the earth contains vast quantities of fire, which is the source of the principal part of the heat on the earth, the cause of vegetation, of earthquakes, and volcanic eruptions, and of hot springs.

See Buffon and Darwin's Botanic Garden. Additional Notes, p. 145. New York Edition.

There are some reasons to believe that particular parts of the earth abound with fire, or masses of burning lava. This opinion is supported by the issuing of smoke from the craters of certain volcanoes for years in succession without any eruption of fire.

But the theory which ascribes earthquakes to steam or vapour, appears to be very unsatisfactory. How can steam be collected within the bowels of the earth sufficient to shake a continent of 3000 leagues in extent. If a great quantity of water should by accident fall on a mass of burning lava, the effect would not be a general equable shake or concussion over a whole quarter of the globe, which sometimes happens in earthquakes; but a violent shock at the place of contact, and a disrapture of the earth, by which

which the force of the steam would be suddenly discharged into the atmosphere. This, however, is not the fact. Almost all earthquakes in North America are progressive, beginning in the interior of the country, and proceeding towards the ocean in a direction perpendicular to the line of shore; that is, from North West to South East. Perhaps we can find a satisfactory solution of this phenomenon upon electrical principles; but no cause can be found in the known properties and effects of steam.

One of the arguments used to maintain the theory of steam, is derived from the known fact that springs and streams are usually exhausted by extreme drought, some time antecedent to earthquakes and volcanic eruptions. But the fact, instead of supporting the theory, operates to destroy it.

The hypothesis supposes, that, at certain times, the springs in the vicinity of burning lava descend and fall upon it; and the water being raised into steam, and extremely rarefied, expels the burning materials in volcanoes with great violence; and in earthquakes, the force of the steam alone ascends and shakes the earth.

But why should the water of the springs find passages to the lava at sometimes and not at others? If the passages were always open, the water would always descend. If they are open at particular times only, there must be some sub-

subterraneous force exerted to open them before the water comes in contact with the fire; the effect then, or disrapture, must take place in a certain degree before the supposed cause can operate. Consequently the force exists anterior to the disrapture which brings the water in contact with the fire. This conclusion supercedes the use of vapour.

But by what magic does it happen, that all the springs and rivers in the neighbourhood of a volcano, for instance, disappear about the same time? By what mutual consent can this remarkable phenomenon be produced? And why, after the eruption, do all the springs and rivers resume their former channels? Is it possible to suppose, thousands of passages, scattered over many leagues of earth, to be all opened at once to convey subterranean springs to a particular place a few months anterior to an eruption of fire; and after the eruption, to be all closed at once, and the water compelled to run in its former channels? Yet all this must be admitted on the theory of steam.

That large volumes of water are sometimes thrown into the basons of volcanic mountains and ejected is true; but, in such cases, the disrapture is occasioned by a previous earthquake or force of fire; and the water is discharged in mals; not in the form of vapour.

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It is a fact authorized by all history and observation, that great earthquakes and volcanic eruptions are often, if not usually, preceded by severe and universal drought. This drought often extends over whole continents; and I find that the defects of water which occasion the terrible famines in Egypt, India, and China, of which we have many accounts, happen generally, (and I suspect always) a few months before and during some great discharges from volcanic mountains. I have certain evidence that this failure of rains and springs sometimes occurs ten months before the eruption. This was the fact in Bengal in 1769; and in America in 1762 and 1782. At other times, the drought happens during the eruption; and in some cases it is continued for two or three years, in which eruptions take place in different parts of the world.

The drought, on such occasions, is not occasioned solely by a failure of rain, but by the concurring influence of excessive evaporation. This fact is capable of demonstration. Sir William Hamilton, Univ. Mag. August 1795, in his account of the eruption of Vesuvius in 1794, informs us, that some days previous to the discharge, the great fountain at Torre del Greco began to decrease, so that the corn-mill worked by it moved slowly. In the wells of the town the water fell, and it was necessary to lengthen the ropes daily. Some wells became quite dry.

In

In a vineyard, near the town, some persons were alarmed eight days before the eruption by a sudden puff of smoke and explosion from the earth.

It is recorded, that Pherycides foretold an earthquake in Greece from the sudden failure of water in a well. These facts indicate unusual evaporation.

It is observable also, that the exhaustion of water extends in such cases to a greater depth than usual. The earth, below the usual influence of the sun's heat and of rains, loses its natural moisture. Such probably was the case in 1782, when the cedar swamps in New Jersey took fire and burnt to the depth of many feet. And this is probably what Livy meant, when, in speaking of the terrible drought in Rome before the great eruption of Etna, B. C. 426, he uses the words "*ingenito humore egens*;" a failure of native moisture.

In the vicinity of volcanoes, this evaporation may be accounted for on the principle of subterranean heat, which is sensibly increased some time before an eruption. But this solution cannot apply to countries a thousand leagues distant, which suffer extreme evaporation at the same time.

There appears to be no way to account for the phenomenon but by the great principle of action, *electricity*. Indeed the discovery of the fact, that most earthquakes happen under particular phases

phases of the moon, and that volcanic eruptions are obviously affected by her position in her orbit, seems to place this point beyond question.

It seems, then, to be very certain, that the electricity which exists in and about the earth is essentially influenced by the sun, moon, and planets, but especially by the larger comets which pass near the earth. The influence of these bodies, or the essential laws of the universe, disturb this fluid, and vary its distributions and its combinations with other substances. Previous to earthquakes, volcanic discharges and hurricanes, it is evident, from many phenomena already enumerated, the electricity of the earth passes out of it in unusual quantities; and as the air is often a bad conductor, the fluid attaches to it, and carries along the water upon the surface, and within the bowels of the earth. This process, continued for some weeks and months, exhausts all the rivers and springs. The atmosphere, in the mean time, becomes more and more dry, and a worse conductor, until both air and earth become perfectly electric, or non-conductors. In this situation, either a great demand for the fluid in some distant region, or a great accumulation of it in the bowels of the earth, has prepared the way for a sudden explosion; but no conducting medium exists sufficient to convey it. A fall of rain, at this time, may create that medium; and hence

hence the common fact that earthquakes happen soon after rain, succeeding severe drought. If no rain falls, the fluid accumulates till it forces a passage through the great apertures formed for the purpose, the volcanic mountain setting fire, on its way, to the hydrogen, and other inflammable substances which the ocean generates or deposits in their bosoms.

I know not that these conclusions are just; but the facts from which I reason are indisputable. The uncommon discharges of electricity, *previous to these great concussions*, are indicated not only by the exhaustion of streams and springs, but by many phenomena in the atmosphere, showing it to be highly electrified. Meteors, huge globes of fire, shoot through the air, not only *after*, but *before* the eruption. Witness the meteors of 1758, 1762, and one in May 1783, mentioned in the preceding history. And Sir William Hamilton informs us, that the air was unusually charged with electricity some days before the eruption of 1794 *. Unusual halos and mock-suns, fiery and lumi-

* May not the appearance of certain epidemic diseases of inflammatory diathesis be ascribed to this too highly electrified, and of course, stimulant state of the atmosphere? The influenza of 1768 was preceded by a meteor or fiery globe. In 1758 was a meteor, and the measles began in America.

luminous appearances in the heavens, with extraordinary tempests and hail, are evidences of the same fact.

The idea that the heat which we experience exists in and about the globe, is, undoubtedly, well-founded. The sun is probably the great electric of the system, which excites into action the heat of the atmosphere and the earth; but there is no reason to believe that heat is principally derived from that body. The solar rays constitute a very small part of the heat of the earth; but they excite it by the rapidity of their motions, or by decomposing that which exists in the air and earth.

Hence there appears to be little foundation for the opinion, that the inferior planets, which are nearest to the sun, have more heat than Saturn and Jupiter. If heat is diminished in the ratio of the squares of the distances from the sun, it is on the principle that heat consists in solar rays; but this is a very questionable doctrine. Light is a substance, but does not necessarily contain heat; at least not any that is perceptible.

In 1771 a meteor, and then commenced influenza and measles. In 1775 a meteor, and the cynanche maligna prevailed. In 1783 two meteors, and then commenced measles and scarlatina anginosa. In 1788 a meteor, and immediately began the measles. If these coincidences are all the work of chance, they are certainly a very singular kind of accidents. More facts and observations than I possess are necessary to settle this question.

It

It is probable, that if the solar rays falling on Saturn, are diminished in number, according to the doctrine of diverging lines, that this defect is supplied by an increase of density or susceptibility of excitement in the atmosphere of that planet. The density and capacity of being excited may be in a direct proportion to the solid contents of the planet, or in a duplicate ratio to the distance. Hence the larger planets are placed at the greater distance. And on this principle there is no ground to calculate, as Newton has done, the extreme heat which comets acquire in their perihelium. No substance of which we have any knowledge, could sustain the intensity of heat which he has calculated the comet of 1680 must have received. It is more consonant to the general arrangement of the universe, as far as our limited understandings can comprehend it, to suppose none of the great orbs that roll in infinite space, are either over heated or over cooled. Every orb has probably its own fund of heat, and the capacity of being excited, suited to its place and destination. The planets, the comets in the parts of their trajectories most remote from the sun, and even the sun itself, may be inhabited*.

In

* I take this opportunity in discussing the question concerning the origin of heat, to notice what philosophers have said on the subject of the internal heat of the earth: Darwin, in his *Botanic Garden* (Note 6.) alleges the earth,

In a knowledge of mathematics, and the application of mathematical principles to the material system,

below the depth of about ten feet, to be always of the same temperature, which is 48 degrees by Fahrenheit. He cites Dr. Franklin's observation, that spring water at Philadelphia is of 52 degrees, which, he supposes, a proof of internal heat from central fires. For as the climate of North America is colder than that of England, he could not account for the excess of heat in the water at Philadelphia, beyond that of England, but by presuming it to be occasioned by internal fires. Yet in another passage in Note 7, the author intimates that he had an idea of a difference of heat in different latitudes, derived from the action of the solar rays. Yet I cannot find any European author who appears to have had a correct idea of this subject; and Mr. Jefferson, in his notes on Virginia, (Query 5.) has manifested his ignorance of it by a most egregious mistake. Speaking of a cave in Frederick County, he informs us, that the thermometer, which stood at 50 degrees in the open air, rose to 57 degrees in the cave. He then adds the following remark: "The uniform temperature of the cellars of the Observatory of Paris, which are 90 feet deep, and of *all subterranean cavities* of any depth, where no chemical agents may be supposed to produce a factitious heat, has been found to be 10 degrees of Reaumur, equal to 54 and a half of Fahrenheit. The temperature of the cave above-mentioned so nearly corresponds with this, that the difference may be ascribed to a difference of instruments."

It seems a little strange that so gross an error should have passed uncorrected till this late age, on a point of fact so easy to be ascertained.

The truth is, the temperature of the earth, below the diurnal and annual influence of the solar rays, which may be perhaps 10 feet in solid earth, and 30 feet in open wells,

system, Newton is, and probably will be for ever, unrivalled. But modern philosophers enjoy the benefit

is regulated by the proximity of place to the equator, subject to small variations from the position of the place in regard to the ocean and the height of the land.

But what is remarkable, this temperature of the earth and water, in the interior of the globe, is precisely the *mean temperature* of the climate in the place where the observation is made. Thus, let the highest and lowest points be taken daily by any good instrument, and divide the sum of all the observations by the number of days in the year, the quotient will be the mean temperature of the climate, and precisely the temperature of the water, below the variations of heat and cold. If any difference should be found, it must be owing to inaccuracy in the observations. It is more usual to take three observations daily; at sun-rise, the coldest time in the day; at two or half after two P. M. the warmest time; and at sun-set, which is found to be the mean temperature. By observations made in the city of New York for one year, I found the mean temperature to be 53 and a half; but this is one and a half degree too high, owing to an excess of heat *within the city*, beyond the general temperature of the climate. The air in a city cools less at night than in the country; and hence the morning observations were found to be too high. In many instances, ice as thick as glass was formed a mile from New York, when an accurate thermometer in the city fell no lower than 40 degrees. Hence the great error of determining the temperature of a climate, by observations made in a large city, which is often done in Europe.

The mean temperature of the climate in England is 48 degrees; that of Paris 54 and a half. This difference is owing to the insular situation of England; the atmosphere in the vicinity of large tracts of water being always more

benefit of many discoveries made by experiments and by collections of facts, which give them an eminent

temperate than on continents at a distance from the sea or great lakes.

The following is the mean temperature of the climate of the respective places, ascertained by observations,

London, North Latitude,	51° 30	temperature	48°
Paris - - - - -	48. 50	—	54½
Quebec - - - - -	46. 48	—	42½
Rutland, Vermont - - - - -	43. 34	—	43½
Salem, Massachusetts - - - - -	42. 30	—	47
Hartford, Connecticut - - - - -	41. 44	—	49½
New York - - - - -	40. 42	—	52
Philadelphia - - - - -	39. 56	—	52½
Virginia, Frederick - - - - -	39. nearly	—	57
Charlestown, South Carolina - - - - -	32. 44	—	66

Allowing a trifle for differences of instruments, this table presents to view the various mean temperatures of the climates mentioned.

From this table naturally arise two observations. First, the great difference between the climate in Europe and America, under the same parallels of latitude. Thus London, in 51 degrees north, has a mean temperature almost as mild as Hartford in 41. Paris, in the 49th degree, has a climate nearly as mild as the northern parts of Virginia in the 39th, and warmer than New York and Philadelphia in the 40th.

Again, we observe the great effect of the ocean upon the climate. Salem, in Massachusetts, is upon the sea shore; and Rutland, in Vermont, 50 or 60 leagues distant; and one degree of latitude difference in the position of the places; yet the climate at Rutland is three degrees and a half colder than at Salem. On the other hand, Quebec, remote from the

eminent advantage over the great astronomers of the last century. The ideas of Newton, in regard to the tails of comets, seem to have no just foundation, and to be utterly repugnant to his own principles of the powers of gravity and resistance. He supposed them to consist of vapour or smoke, repelled from the nucleus by the force of the sun's heat. He seems to have been aware of the objection to this theory, from the resistance that must be made to the ascent of the vapour by the celestial ether; and therefore supposes an extreme rarefaction to take place, which removes that resistance.

But whatever rarefaction may be supposed, still it will remain an incontrovertible principle in

the sea, though on a river, with three degrees difference of northern latitude, has a difference of only one and a half degree in climate.

To ascertain the mean temperature of any given place, it is only necessary to plunge a good thermometer into water, taken from a depth in which the temperature is uniform at all seasons of the year.

The mean temperature of water within the tropics is not exactly known, but it must be very near 80° by Fahrenheit.—Water drawn from a depth of 200 feet in the West Indies, is cooled by filtration in the air, above the earth, in those hot regions.

The difference in the temperature of Europe and America, under the same parallels, is nearly that of ten degrees of latitude.

See Holyoke's Register of the weather, Mem. Am. Acad. vol. ii. part 1. William's Hist. of Vermont.

physics, that no substance that has *gravity* can be supported but in a medium which has *more gravity*. The vapour supposed in the present case could not be maintained in straight lines, without medium of greater density to support it. Now, any medium capable of supporting vapour, must furnish great resistance and very much retard its velocity*.

With these known principles in view, let any man calculate the velocity of vapour, driven from the nucleus of a comet, necessary to preserve a direction nearly opposite to the sun, in its perihelion passage.

Comets enter the solar system in various directions; the planes of their orbits making various angles with that of the ecliptic. Their orbits are nearly elliptical, and the sun is in one of the foci of the ellipsis. By the universal law of planetary motion, according to which all revolving bodies describe equal areas in equal times, the motion of comets must be very rapid in their perihelion. The comet of 1770 was calculated to describe an arch of 50 degrees in 24 hours. This seems hardly credible; but many comets describe an

* I submit it to mathematicians whether, on Newton's own principles, an atmosphere of density sufficient to support a cannon ball, would not retard its velocity as much as the present atmosphere does a feather put in motion. If so, his rarefaction does not in the least aid the ascent of vapour from the body of a comet.

arch of 180 degrees, a semicircle, in 30, 40, or 50 days.

The perihelion distances also of the various comets are very different, and so are the lengths of their tails; some of them extending a small distance, and others to 60 and 80 millions of miles.

Suppose the perihelion distance to be 30 millions of miles, and the length of the coma to be 70 millions. In this case the extremity of the tail must be 100 millions of miles from the sun. Now, either the vapour which is supposed to constitute the tail, must be shot from the nucleus with such rapidity as to reach the extreme point of the coma in a few hours; that is, it must pass through 70 millions of miles in a very short time, to preserve a direction nearly opposite to the sun: or the whole coma must move forward with the nucleus. In the latter case, the extremity of the coma must pass along the periphery of a circle*, whose radius is a line from that point to the sun, or 100 millions of miles. Of course, while the comet describes an arch equal to a semicircle, the extremity of the coma must pass through the space of 150 millions of miles. I believe no kind of vapour, of which we have any knowledge, could perform either of these journeys in the time

* The figure would not be a circle, but it is not material to the argument,

given.

given. On the other hand, that dense gravitating substance would not have passed through the distance supposed, from the creation of the world to this time.

On subjects of this kind we cannot arrive at certainty. All we can do is, to reason from analogy and form probable conjectures. We know of no substance in creation capable of producing the phenomena of the comas of blazing stars, except electricity or light. No other species of matter passes with a rapidity that will solve the phenomenon of the length of the coma, preserved in a direction opposite to the sun. The theories of Kepler and Hamilton are more rational than that of Newton. The tails must consist of electricity, repelled from the nucleus by the force of the sun; or must be merely the rays of light, coloured by their passage through the comet's atmosphere. These hypothesis may not solve *all* the phenomena; but they will account for the principal, and are repugnant to no philosophical principles.

The curvature of the coma has been alleged as an objection to this hypothesis. But in fact, this is a confirmatory argument in favour of it, for it is analogous to the curvatures formed by ascending streams of electricity in the lumen boreale; indeed, it seems to be a law of electricity to move in bending lines, and, for any thing that we know,

know, this phenomenon may result from the nature of that species of matter, and be independent of resistance.

In regard to the transparency of the tail, it resembles also the *lumen boreale*. Through both of these luminous appearances the stars shine with undiminished lustre; but vapour, however rare, would refract their light, and, in a certain degree, interrupt our vision.

An Essay on Comets by Andrew Oliver, published 1772, ascribes the tails of comets to air extremely dilated and repelled from the nucleus by the power of the sun; but this hypothesis is liable to all the objections stated against the theory of Newton.

My own opinion respecting the material system is this, that an atmosphere, the basis of which is electricity, fills infinite space, and involves in its bosom all the solid orbs which shine in the celestial regions. This may be denominated the *mundane atmosphere*. My hypothesis rests on the following reasons.

First, The large meteors or globes of fire are formed in regions far beyond the limit assigned to the earth's atmosphere. Their altitudes vary from 40 to 80 miles. At the height of 80 miles, then, there must be the matter of an atmosphere capable of generating globes of fire of half a mile in diameter; and of communicating sounds as full
and

and distinct as the air near the earth, for the explosion of one of those globes resembles thunder.

Secondly, The lumen boreale has been often calculated to be visible at an elevation of 7 or 800 miles. I do not rely on the accuracy of these calculations, on account of the difficulties attending them. In some instances, we are very certain that this light exists in the regions of the higher clouds.

Thirdly, The tails of comets must be matter, or depend on matter for their colouring by which they become visible. In either case we have evidence nearly amounting to demonstration, that a material atmosphere fills the boundless regions of space.

Fourthly, But an argument of still more weight in my mind, is one drawn from the necessity of such an atmosphere, as the medium of attraction and repulsion—the principles that connect and bind together the vast orbs that roll in ethereal regions. I can have no idea of such an immense power exerted in an immense void or vacuum.

It seems probable, that the parts of our atmosphere which constitute *weight*, and influence the barometer, are limited to the distance of a few miles from the earth. Water, for instance, is a substance destined to answer certain purposes on the globe, and is probably confined to its neighbourhood.

But

But the principle of electricity may be, and undoubtedly is, a non-gravitating and permanently elastic substance. This may be diffused through infinite space, and, by its amazing elasticity, may be capable of communicating motion or force from planet to planet, with the rapidity of light.

Newton supposed infinite space to be filled with a subtle substance which he called *ether*. Had this great man been acquainted with the laws of electricity discovered since his days, he probably would have exchanged the term *ether* for *electricity*.

By means of this powerful principle the planets all influence each other, and become the means of diversifying each other's seasons, sometimes by attracting, sometimes by repelling, and sometimes disturbing the proportions of this substance, or influencing its mechanical laws, by which it is combined or decomposed with other atmospheric substances.

Hence we may account for the frequency of earthquakes, volcanic eruptions, and violent tempests, under particular phases of the moon, and especially during the proximity of comets. The electrical matter accumulated in the earth by its own laws, or by reason of an unusual demand *ab extra*, may, during the approach of these orbs, be suddenly called into action, and occasion extraordinary tumult in the atmosphere.

Perhaps

Perhaps also we may, in this hypothesis, find a solution of the phenomenon, so interesting to man, and so mysterious, why the approach of comets never fails to be attended with epidemic diseases. The fact, in regard to comets which come near the earth, is unquestionable; and it is equally certain that earthquakes, volcanic eruptions, meteors, and many other electrical phenomena, are, at such times, more numerous and violent than at other times.

Now it is proved by experiments, that the fibres of living animals are the most perfect conductors of electricity, while the integuments which cover them are non-conductors. A consequence of these principles must be, that in all the motions or operations of electricity in the atmosphere, the nerves must be the principal subjects of its influence. Hence if the atmosphere is, at times, electrified beyond the degree which is usual, and necessary to preserve the body in a due state of excitement, the nerves must be too highly excited, and under a continued operation of undue stimulus, become extremely irritable, and subject to debility. Shall we not find, in this hypothesis, a rational solution of the phenomenon which has puzzled medical men, the excessive irritability of the nervous system, in times of epidemic diseases, which facilitates the invasion of fever? Shall we not account for the eruptive diseases which always precede pestilential epidemics, on the principle

ciple of the great debility of the extreme vessels, induced by the weakness of the nerves which spread over the human body near the surface; by which means those vessels are rendered incapable of performing their usual secretions? Shall we not be able to account for the remarkable coincidences in time between the influenza, and unusual electrical phenomena, as volcanic eruptions and earthquakes? May we not account for epidemic measles, in those years when the atmosphere shows evidences of high electrification? And will not this principle explain the diseases among animals, the defect of vegetation, and the extraordinary generation of insects, during pestilence? It is well known that vegetation may be greatly accelerated by artificial electricity. Is this effect produced by what is called *excitement*? And if so, how do we know that a similar power, operating on the elements, may not call into existence innumerable insects? To what other principle shall we ascribe the *unusual size* of common insects, when they precede and accompany pestilence, a fact well attested? There must be a cause for these phenomena; and where shall we find it, but in the universal principle of excitement?

It is now agreed among philosophers, that electricity is the immediate agent in the formation of rain, snow, and hail. In confirmation of this theory, my enquiries into the cause of epidemic

diseases have led to a discovery, that those years when volcanoes discharge great quantities of fire and lava, including some months before and after the discharges, are, by a great difference, most productive of hail. Hence the immense damage done by hail-storms in those seasons which are excessively dry and hot; these years being closely attendant on volcanic eruptions. The theory which ascribes hail to extreme cold is defective. We know that pieces of ice of three, six, and even nine inches in circumference, sometimes fall in hail-storms. By the laws of gravity, a hail-stone must begin to fall as soon as it begins to be formed; and as it requires but a few seconds to descend, it is easy to conceive that mere cold cannot occasion a congelation rapid enough to form pieces of ice of half a pound weight. The process is electrical, and almost instantaneous; and we know that real snow may be artificially and instantly produced by means of condensed air and electricity. Hence we are led to the causes which connect severe winters with volcanic eruptions; and we derive the extreme heat of summers and cold of winters, which so generally accompany pestilence, from the same cause, a super-abundance of electricity.

Hence we are led also to the cause of the apoplexies, lethargies, and eruptive diseases, which almost uniformly follow great volcanic discharges and earthquakes in Italy. The system, and especially

cially the nerves, are excessively excited, and lose their energy.

It is on the same principle also that we explain the phenomenon of freezing, when the thermometer is above the usual point of frost. This has been observed near volcanic mountains, where the atmosphere is highly charged with electricity. In 1730, Dr. Cyrillus found by a thermometer made by Hauksbee, that water, near Vesuvius, froze with the mercury ten degrees above the freezing point.

Phil. Transf. No. 424. Bad. Mem. vol. ix. 299.

The nature of this element, electricity, is little understood. It is the modern opinion that heat and light are only modifications of the same element. This is analogous to what we know of water, which exists in the form of water, of visible vapour and air.

It is supposed that electricity cannot be insulated in the human body. But if it cannot be insulated in the form of *electricity*, may it not in the form of *heat*, and thus be the direct cause or matter of inflammation? If it can be accumulated and insulated in this form, may not conductors be formed to draw it off in the form of electricity? Mr. Vinal relates, that he speedily removed local inflammation occasioned by a burn and scald, by the application of a negatively charged electrical machine.

Mem. Amer. Acad. vol. ii. 144.

Should this doctrine be well founded, the success of metallic points in removing topical inflammation will be explained and established.

The proofs of the altitude of the atmosphere, from the power of refracting light, are now known to be fallacious. No man will suppose the atmosphere to be less elevated in the equatorial regions than in the polar circles; yet the duration of twilight under the equator, being less than in places remote from it, proves that the power of refraction will not determine the height of the atmosphere. The power of refraction is in a direct ratio to the diminution of heat, or increase of cold, in the atmosphere, or perhaps to the increase of electricity.

Nor will it be correct to say that the power of refraction depends on the density of the atmosphere, unless density can exist independent of gravity. The atmosphere in the polar and temperate regions raises the barometer no higher than under the equator; nor is the mercury in barometers generally higher in winter, when the thermometer, by Fahrenheit's scale, is 10 degrees under cypher, than in summer, when it is at 98°, the temperature of blood-heat.

If density implies or involves in it gravity, then the atmosphere at the equator is as dense as in any distant latitude; for the barometer is as high in one as in the other. But if the atmosphere is as dense and as heavy, *ceteris paribus*, in one
lati-

latitude, as in another, then the power of refraction does not depend on density; for the powers of refraction, in different latitudes, are various.

It is indeed very questionable, whether density and gravity are the principles which wholly influence the barometer. The barometer falls as it is elevated above the surface of the earth, but the atmosphere retains all its powers of sustaining respiration and circulation at an altitude of 15,000 feet.

What are the aërial phenomena that attend a fall of the barometer? How can the weight of the mass of air, surrounding the globe, be suddenly taken off, over a whole continent? What becomes of its gravity, and the principle of attraction on which it is supposed to depend? Are they removed, expelled, or suspended?

I suspect the theory which assigns to the barometer the province of determining the *gravity* of air is fundamentally defective; and that, instead of variations in its *weight*, we experience only variations in the combinations of its parts, which diversify its elasticity, and its operation on the barometer, as well as on the human body. When the atmosphere is full of vapour the barometer usually falls, and we feel a depression of spirits. It can hardly be true, that the pressure of the whole atmosphere is less at such a time than when the air is clear and the barometer high; for this vapour circulates near the earth, and the higher regions of the air are as clear and as pon-

derous as usual. If the density of the air near the earth should be lessened, the consequence must be the air, from higher regions, which retains its gravity, must rush in to supply the defect.

The only way to account for the variations of the barometer, appears to be on the principle before-mentioned. The air appears to be less elastic when the heat is combined with vapour, and the mercury falls. It seems necessary to take into view these considerations in order to solve the phenomena: The general pressure of the atmosphere, or gravity, which is probably uniform, together with the various changes in its elastic powers, which occasion the vibrations in the barometer.

Every dairy woman knows that thunder and lightning will almost instantly coagulate milk; that is, when electricity is united with vapour, and passes, in a visible form, from cloud to cloud, or between the clouds and the earth, *milk turns* or coagulates. So it does during a rainy day in summer, without thunder, with the thermometer at 64°, as I know, by observation. This condition of the atmosphere, may be called its *decompounded* state. The barometer falls, vapour becomes visible, the functions of the body are languid, milk coagulates, objects contract mould, in short, the atmosphere is unelastic, and ill-fitted to maintain vigour in animal or vegetable bodies.

I have remarked in the preceding pages, that a pestilential atmosphere is not corrected or moved
by

by the force of wind—no tempest expelling an epidemic fever from a city, unless at the close of the season, and accompanied with heavy rains. How can we solve this difficulty, but upon the hypothesis of an electrical atmosphere which is stationary?

Dr. Franklin proved, that “an electrified cork ball, at the end of a silk thread, whirled never so rapidly through the air, for a length of time, lost none of its electricity. He found also, by an experiment, that, an electrical atmosphere raised round a thick wire, inserted in a phial of air, drives out none of the air; nor, on withdrawing that atmosphere, would any air rush in.”

On Electricity, London Ed. 97.

It is also proved, that a most violent blast of wind thrown across a stream of electric matter, has not the least effect upon it.

These experiments prove, that air furnishes no sensible resistance to the motions of electricity, and that it exists in air without expanding or compressing it. In short, it proves, that electricity acts entirely by its own laws, and is not controlled by the agitations of the air.

Will not these observations throw light on the fact of a stationary atmosphere in cases of pestilential epidemics? Is not electricity the basis of the common atmosphere, and unmoveable by wind? And does not a pestilential air consist

partly in some combinations of this element with other aërial substances, which are not moved by wind? This is suggested merely for consideration, for it appears, to me, improbable. Frost destroys the pestilential condition of the atmosphere, and this is supposed to act upon the deleterious substances arising from the earth, or human body. Besides, a pestilential atmosphere rises but a few feet above the earth, which indicates that its pernicious qualities are dense and gravitating substances.

Indeed, two causes seem to concur in the origin of pestilential fevers; an electrical condition of the atmosphere which renders the nervous system extremely irritable, and the body of course prone to fever; and a collection of morbid matters arising from living* and dead animals, and putrifying vegetables. Wind may remove the latter cause, if accessible, which, however, is never the case in large cities, but cannot affect the influence of the former. Frost has access to all morbid causes and renders them inert; it also reduces the stimulus acting on the human body and renders it

* I mention the morbid matters from living bodies among the causes of pestilence. I am persuaded that perspiration in cities furnishes more poison than streets and alleys. It fills all close rooms, especially bed-rooms, and in close-built streets it infects the very atmosphere; and a more violent poison does not exist than perspirable matter in a condensed and fermenting state. This can only be destroyed by a liberal use of water.

less irritable. But the electrical stimulus remains. Hence, although the progress of the fever is arrested by cold, the type of it is visible in the diseases of the winter. The irritability of the system, from electrical causes, still remains, and gives to the fevers of winter the peculiar symptoms of pestilential, or typhus, pleurisy and peripneumony.

A remarkable property of electricity is to give polarity to the needle of a compass. A violent stroke of electricity destroyed the virtue of the load-stone, and reversed the ends of the needle of the compass on board of Capt. Waddell's ship, in 1751; and a suitable discharge of that element will give polarity, like the magnet. Hence, it is concluded, that magnetism depends on electricity, but in what manner seems to be mysterious.

It is well known that the needle is subject to variations, which are different in different parts of the earth, and, in some degree, periodical. It has also a small diurnal variation, receding from the east, or *influence of the sun*, from eight o'clock in the morning to two in the afternoon; and from the west, or the same influence, from two o'clock to nine, P.M. and during the night remaining stationary. Is not this owing to the repulsion of light and heat? If so, is there not an analogy between this diurnal variation and the phenomenon of polarity? If light and heat, falling on one side of the needle, repel it in a small degree,

is, it not rational to conclude that the equatorial heat should repel the magnetic point, and direct it to the north? That is, the needle points towards that portion of the atmosphere which is most perfectly electric.

It may be objected that the needle does not always direct itself to the same point: True, but there is some periodical revolution in the electricity of the terrestrial regions; at least the appearance and disappearance of the *lumen boreale*, at certain periods, warrant this suggestion. It seems to be admitted, that there is a current of electricity from the equatorial regions towards the polar regions within the earth; and in the upper parts of the atmosphere a current of the same element from the poles towards the equator. This idea is derived, in part, from the *lumen boreale*, and receives countenance from the fact, that a bar of iron, standing directed towards the pole, will acquire polarity or magnetic properties; but directed towards other points in the heavens no such effect is produced; indicating a stream of electricity passing through the bar, from the centre of the earth towards the pole, but not in any other direction.

Should this idea be well founded, and should it be admitted that the *lumen boreale* is a current of electricity from the north to the south, will not the periodical appearance and disappearance of this light indicate a revolution in that current
about

about the axis of the earth, or, perhaps, an axis of its own? If so, on what laws does it depend, and how will it agree with the variations of the compass? It will be said, that the variations are different in different places, and are not uniform in the same place.—True; but the general course of variations in the same place is tolerably uniform.

With respect to different degrees of variations in various places, I have one observation that is probably new. It is very probable, if not evident, that the *distributions* or *forces* of electricity are different in different quarters of the globe. I say *distributions* or *forces*; for a difference in the state of existence or modes of acting, will as well account for the phenomena as difference in quantity. My reasons for this opinion are, that the barometer has different altitudes in different places at the same time. The mean altitude for a month or a year in places of the same elevation, is very various. Hence we conclude, that the weight of the atmosphere cannot be the cause of these variations, for this, on a level of the ocean, must, on hydrostatic principles, be every where the same. Yet the actual differences amount to one half or two thirds of an inch.

See Phil. Transf. No. 435. Bad. Mem. vol. x. 81.

It is easy to account for this difference of pressure on the principle of different combinations of
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the electric principle with vapour or other local matter in the atmosphere which may vary the *force* or elasticity of the air; but I do not see how the *weight* of a fluid alone, whose pressure must be equal, if of equal height and density, can account for these differences. It is utterly repugnant to all known principles of the equable pressure of a gravitating fluid, to suppose a mere change in the form or composition of that fluid should alter the absolute weight. Water admits none of these varieties, being always of equal density and gravity at equal altitudes.

On the same principle of a difference of pressure or elasticity in air and water, without a change of weight, perhaps we may account for the very different elevations of the tide in different places, and, in some instances, in the same latitude. Is it not rational to conclude that the electricity is various in its combinations or quantity in different places, according to the heat of the climate, the neighbourhood of land and high mountains, or perhaps to the seats of volcanoes? The fact, that tides do not rise as high on the main ocean as near land, seems to countenance this idea. It seems to indicate, that the medium by which the moon influences the water, has different powers near the land, and at a great distance.

Another fact that seems to favour the hypothesis that electricity is the instrument of tides, is the great irregularity of tides. In many instances

stances there have been preternatural ebbings and flowings of the tide; some times the river Thames, for instance, has been left almost dry for many hours, when there has been neither wind nor earthquake to account for the phenomenon.*

These

* A recess of this kind is mentioned in 1114, when the Thames for the whole day, on the 15th of October, was so low, that children waded over between the Tower and London bridge. In 1247 there was a cessation of the flowing of the tides for three months, before a severe earthquake. See Short, vol. ii. 145. I should not be inclined to credit these relations if modern observations did not serve to confirm them. On the 11th of March, 1785, and 25th of January, 1787, the Tiviot, a large river in the south of Scotland, receded and left its channel dry, in the former instance *two hours*, and in the latter *four*. No convulsion of the earth was known in that neighbourhood, nor within two or three weeks of the first instance. An earthquake happened on the 26th of January, the day *after* the second instance, but could not be the cause. A similar recess happened on the day of the earthquake in the river Clyde.

On the 12th of September, 1784, in perfectly calm weather, the water in the Loch Tay, in Scotland, suddenly ebbed 300 feet and left the channel dry, then flowed again, and thus alternately rose and fell for two hours. The same phenomenon, in a less degree, occurred in several succeeding days. Sinclair, vol. vi. 624.

The facts related of the sea and rivers in Holland on the day, but not at the hour, of the earthquake at Lisbon, in 1755, where ships snapped their cables, and water dashed over the sides of vessels, without the least sensible motion of the earth, are strong proofs of the same insensible but immensely powerful action of the electricity of the globe. The swelling

These irregularities have invariably happened in years which have been remarkable for electrical phenomena. To this point I have paid particular attention. They are not always attendant on earthquakes or volcanic eruptions, but they occur in the same year or near the same period; evidencing that when those visible discharges take place, insensible discharges take place in remote countries, and on the opposite side of the globe.

Should it be admitted that electricity may be unequally distributed or operate with different

swelling of the ocean in the time of earthquakes is not so much owing to the rising of the earth beneath, as to the force of electricity. The intumescence sometimes begins *before* the shock, as it does *before* hurricanes in the West Indies.

In Scotland, during the great earthquakes in Calabria, in 1782, the water in the lochs was agitated without any motion of the earth, and the mercury in the barometer fell within the tenth of an inch of the bottom of the scale. On the 12th of February, 1787, the barometer at Edinburgh fell nearly to the same point.

These phenomena can be resolved into no cause but some operation of electricity, and they add much weight to my suspicions, that tides are governed by some laws of electricity, which are influenced by the phases of the moon.

The great fall of the barometer in Scotland is a strong evidence that the same energetic principle governs that instrument. It is absurd to suppose the atmosphere could have lost such a portion of its weight. Indeed it is far from being impossible that the rise and fall of the barometer may be occasioned by the force of electricity acting on the quick-silver itself.

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forces, in various places, according to its combinations with aerial substances at different times; we may find some probable causes of the great diversity of diseases in the same year, as well as of the different heights of the barometer. The stimulus applied to the human body may be different in various places, according to the predominant operation of one or more of the following causes.

I. Soil, which may affect the air in various ways.

II. Situation in regard to elevation, to water, hills, mountains, minerals, fresh air.

III. The population of places, and all the consequent evils of noxious exhalations.

IV. The cultivation of a country which has a most salutary effect on the atmosphere.

It is very certain that the condition of the atmosphere is very different in places which appear to be equally favourable to health. Children and valetudinarians are very sensible of these differences. It is hardly possible to remove an indisposed person a distance of five miles without a sensible effect on his health; he is better or worse

worse in his new atmosphere. Under the combined operation of such various causes, we are not to be surprised at the irregularity in the appearance of autumnal and epidemic diseases.

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